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Hazardous Waste Management Issues Pertinent to Section 3004 of the Resource Conservation and Recovery Act of 1976

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HAZARDOUS WASTE MANAGEMENT ISSUES PERTINENT TO SECTION 3004 OF THE RESOURCE CONSERVATION AND RECOVERY ACT OF 1976

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EXECUTIVE SUMMARY

Section 3004 of the Resource Conservation and Recovery Act of 197 (RCRA) requires that regulations be promulgated by the U.S. Environmental Protection Agency (EPA) Administrator

> establishing such performance standards, applicable to owners and operators of facilities for the treatment, storage, or disposal of hazardous waste . . . as may be necessary to protect human health and the environment.

The standards are to include requirements respecting

> contingency plans for effective action to minimize unanticipated damage from any treatment, storage, or disposal of any such hazardous waste [§3004(5); and] the maintenance of operation of such facilities and requiring such additional qualifications as to ownership, continuity of operation, training for personnel, and financial responsibility as may be necessary or desirable [§3004(6).]

On June 8, 1977, EPA commissioned International Research and Technology Corporation to examine the issues pertinent to these standards and to evaluate the possibility of EPA certification of operations. The resulting study defined regulatory objectives under four headings: financial responsibility; continuity of operations; contingency plans; and training and certification. It identified and evaluated alternative approaches and methods to meet the objectives, and estimated potential costs where possible. The study was specifically required to furnish recommendations on the issues of training and certification.

The hazardous waste management industry is not monolithic: term covers significantly different types of firms, types of operations, and types of wastes. For purpose of this study the industry was defined to include only those required to obtain permits pursuant to RCRA §3005. First, the industry includes manufacturing companies for whom hazardous waste management is an incidental responsibility generated by their own activities; it includes independent firms principally in the business of taking the hazardous wastes generated by others and disposing of them; it includes private sector firms as well as public facilities operated by states, municipalities and regional authorities. Second, the industry includes different types of operations: storage, treatment, and disposal, each with different management problems, potential liability exposures, challenges to continuity of operations etc. Some firms may be involved in only one of these operations, others in all three. Third, while the definition and identification of hazardous wastes under RCRA had not been completed during the period of the study, it is evident that waste materials to be classified as hazardous will range from the very hazardous to those hazardous only under relatively rare conditions. Some wastes will be toxic, others flammable, corrosive, mutagenic, etc. The longevity of the hazard associated with some wastes will be, for planning purposes, infinite while the hazardousness of others will be substantially over in a few months or less.

Each of these variations has some significant implication for the ease with which the purposes of Section 3004 can be met. One of the objectives of the study has been to identify regulatory mechanisms and performance standards applicable generally to all variations found within the industry.

The principle findings of the study may be summarized as follows.

Financial Responsibility

"Financial responsibility" was taken to mean the ability to pay for injuries to others resulting from escape of hazardous materials. To establish standards for financial responsibility EPA must estimate the possible extent of an owner/operator's potential liability and decide to what degree EPA can and will require the individual firm to insure itself against this potential liability. A review of liability awards arising specifically out of hazardous waste management failures, did not yield data adequate to derive a frequency/liability curve. So far, most claims have been in the $100,000 to $1 million range. However, current trends in casualty insurance suggest that claims are rising rapidly. New awareness of the potential effects of unintended releases of hazardous material into the environment, combined with the rapidly increasing dollar amount of judgements being returned by the courts, lead to the conclusion that potential liability levels are likely to be substantially higher in the future. Against this is balanced the increased safety and effectiveness of the industry that can be expected with the implementation of RCRA operational and contingency plan standards. Regardless, the minimum financial responsibility level to be required will be determined by a policy decision, rather than mathematical analysis.

Typically, firms protect themselves against liability by purchasing insurance. Other methods of assuring financial responsibility include trust funds, captive insurers, self insurance, net assets, and bonding. After examining each of these alternatives, the study concluded that, given the very high, but infrequent, potential liability levels faced by the industry, commercial insurance would prove the most effective way of meeting §3004 financial responsibility requirements. However, there are two obstacles to the insurance solution. The first is that the insurance industry is unwilling to provide substantial liability coverage for small operators at any premium in keeping with the revenue of such firms. The second is that insurance companies are generally reluctant to offer liability insurance for non-sudden releases because of the industry's awareness of the almost unlimited potential liability that could result from gradual progressive environmental deterioration from unjustified causes such as slow seepage. With the issuance of the RCRA hazardous waste management operations regulations some of the uncertainty will be reduced, but until a loss history for the industry is compiled, insurance premiums for sudden accidents will be conservatively over-estimated and coverage for slow leaching of toxic materials will be available only within narrow limits. It appears likely that an insurance industry pool arrangement may be required to meet the financial responsibility objectives of RCRA §3004.

The objectives can probably be met without Federal government assistance or direct financial participation. However, formal EPA encouragement and initiative is essential if the insurance industry is to respond effectively to the financial responsibility requirements of the hazardous waste management industry.

Continuity of Operations

Continuity of operation objectives cover three stages in the life of a hazardous waste management site; active operations; site closure and post-closure operations. Continuity of operation problems arise when the facility operator is 1) no longer available or has gone out of business, or 2) incapable of or unwilling to carry out the functions required for the safe and proper operation of the site. The likelihood of this happening increases when the site ceases to be an economic asset, i.e., if and when the costs of treatment and disposal exceed income from the service, or when the site is filled and can accept no further wastes. The physical needs of the site, which include post-closure care, will generally outlast the immediate economic interest of the operator in its operation.

The problem of meeting post-closure responsibilities is aggravated by the difficulties inherent in predicting when the hazard is terminated. In addition to the uncertainties surrounding their potential exposure to post-closure liability and clean-up costs, hazardous waste management companies may find themselves incapable of judging when their obligations for post-closure operations will end, and faced in some instances with obligations in perpetuity.

In addition to the active operation, closure, and post-closure aspects of continuity of operations standards, other concerns may be considered; emergency access to the site; termination or limitation of operator responsibilities where these may prove an obstacle to the emergence of a healthy hazardous waste management industry; and land-use limitation on closed hazardous waste disposal sites.

Various mechanisms can be brought to bear on these objectives. They include: owner asset requirements, trust funds, bonds, escrows, mutual assessment associations, statutory authority, site transfer, easements, covenants, and zoning.

Trust funds present a general advantage over other possible methods of meeting continuity of operations objectives: funds are built up during the time an operator's income from a site is greatest, and then secured for use when an operator's immediate interest in a site is at its lowest, when it has ceased producing revenue but still requires maintenance expenditures. It is the isolation of the funds that makes this scheme attractive. Regardless of the subsequent history of the operator, society is assured, to the extent it can be, that hazardous waste sites receive the treatment they require over periods of time potentially so long that they exceed the degree of permanence that can reasonably be expected of all hazardous waste management firms. But for the same reason, trust funds present a significant problem: they require the setting aside of funds to which the operator no longer has access. These funds might otherwise be used by the operator in expansion, technological investment, or profit-taking.

The two different types of trust funds--a central industry-wide fund, or individual funds per site and operator--have different advantages and disadvantages. A central industry-wide fund used only for emergency purposes where an operator has defaulted would require a smaller total capital amount than the total capital that would be set aside under an individual trust fund approach. The industry-wide approach takes advantage of the assumption that defaults would happen infrequently and requires all members to share in that risk. The advantage of the individual trust fund approach is that with a strong incentive to meet continuity of operation obligations. Each operator would be reimbursed from the trust fund as the sequence of closure and post-closure obligations was met. Under a central fund approach, where funds are only available for defaults, the individual operator may have no direct financial incentive to carry out its obligations. The central fund, set up for emergency use, may instead find itself having to cover a greater number of sites than originally thought likely, as individual operators who find they have nothing else to lose abandon their filled sites. Individual trust funds would be particularly vulnerable to inflation and the source of the funds would presumably have discharged its financial responsibilities for closure and post-closure costs at the time the fund was created. A central trust fund, with annual assessments being made against industry members for its upkeep, would be able to withstand inflation better as the assessments would reflect costs charged to the fund.

Surety bonds may be used to assure the funds needed for continuity of operations during the period in which the trust fund is built up. Bonds cannot cover long-term or indefinite obligations.

Another key objective is to provide rapid or emergency access to a site that is being mishandled or has been abandoned. RCRA Sections 3008 and 7003 provide for such access, but involve court procedures that are time-consuming. The establishment of a more direct access to hazardous waste sites, possibly as a part of the permit mechanism, is desirable.

The most difficult issue considered under continuity of operation objectives concerns the possibility of transferring ownership of or responsibility for the site from the operator to the government. Providing long-term continuity of operations and financial responsibility for a hazardous waste site is not a trivial undertaking, and a state takeover requires the establishment of a substantial operational capability. Nonetheless, some states, such as Oregon, now require site transfer.

The advantages of site transfer for purposes of terminating a perpetual burden are that individual hazardous waste companies will be able to close their books at the end of each fiscal year with statements of measurable liabilities and obligations outstanding, and that prospective entrants into the hazardous waste industry will not be deterred by the prospect of an open-ended--and potentially catastrophic--responsibility overshadowing their commitment. The disadvantage is that hazardous waste operators would be relieved of legal obligations that have traditionally been assumed by the private sector, only because the *structure* of the obligation is unusually onerous.

Requiring that the permittee own the land in which disposal is taking place will held assure that the land is not subsequently misused, and that access to the site by monitoring and emergency personnel is possible. It also helps prevent insulation of company assets in the case of intentional default.

Post-closure financial responsiblity needs may be met through liability insurance. Annual premiums could be funded, in case of operator default, though the same mechanisms used to pay annual maintenance and monitoring costs.

Contingency Plan Standards

Contingency plan standards are required to help control physically the accidental release of hazardous wastes into the environment. The standards must cover a variety of different types of disposal techniques, different types of hazardous wastes, and different types of incidents that result in the release. The standards selected are relevant to landfills, incineration, deep well injection, waste lagoonsand ponds, near-surface land burial, land burial at depth, above-surface storage, and neutralization. The waste materials covered include flammable or explosive vapor, flammable solids and liquids, explosive solids and liquids, bioconcentratives, corrosives, reactives, radiologicals, and other wastes that present an environmental hazard, or an airborne, waterborne, or contact health hazard. The release events covered by the standards include non-routine liquid, solid, and gas releases, fire, explosion, dike failure and direct human and animal contact.

Standards were examined under the following headings: organization, communication, assessment, and response and recovery. Organizational standards are aimed at insuring a well-defined, effective and coordinated emergency effort, and deal primarily with authority and responsibility in maintaining, implementing and activating a contingency plan.

Communication standards are intended to insure positive and preplanned notification to emergency authorities in the event of accidents or hazardous discharges. An automatic alert to a detached fire department may be required in case of all fires, including short-lived ignition of unexplained free gases, any detonation except one controlled entirely within the operating limits of an incinerator chamber, any situation requiring employee evacuation, any employee injury due to spontaneous rupture of a container, or any release of hazardous gases, fumes or dusts outside the regulated area of the facility.

Assessment standards are aimed at providing prompt appraisal of the extent and severity of dispersion and contamination from the accidental release of hazardous wastes to the environment or assisting in selecting an appropriate response to mitigate potential adverse effects from the release of any contaminants.

Response to an emergency situation must follow immediately after assessment. Response and recovery standards include notification; shut-down of facility; evacuation; monitoring and modeling; collection and/or containment of released wastes; continuing assessment of affected areas; personnel availability; medical treatment; water supply; and fire fighting and prevention.

None of the contingency plan standards proposed are incompatible with existing Federal regulation, or in conflict with the authorities granted under other acts. However, hazardous waste management operators may have to meet additional standards under other acts.

Training and Certification

Most of the operations at a hazardous waste management site require skill and training. Certification is a way of verifying that the labor force at a site has the requisite skills and training. However, a training program need not be accompanied by certification, and vice versa. Under a "grandfather clause" provision, persons who have been in the hazardous waste management business for a period of time may be exempted from either training or certification requirements.

A training and an independent certification program is recommended for the hazardous waste management industry. The industry is in an embryonic form: its personnel are often new to the business and new requirements are being made of the operators in areas in which they may have little experience. The current capabilities found in the industrv vary widely, from well managed, sophisticated, responsible companies to antiquated landfills, to fly-by-night dumpers. A strong training and certification program will help raise and unify standards and help eliminate incompetent operators from what is likely to prove an increasingly demanding and sophisticated industry. A grandfather clause should be included with regard to the training program, but all operators should have to meet the same certification requirements.

PREFACE

The following draft report describes the principal findings and conclusions of a study on hazardous waste management problems. The study was sponsored by the Hazardous Waste Management Division, Office of Solid Waste, of the U.S. Environmental Protection Agency (EPA) and executed by the International Research and Technology Corporation (IR&T) and its subcontractor Dames and Moore during the period June 8, 1977 - September 8, 1978, under EPA Contract No. 68-01-4657.

The purpose of the study has been to examine a number of management issues pertinent to Section 3004 (5) and (6) of the Resource Conservation and Recovery Act of 1976. The study was divided into four tasks, covering:

1) Financial responsibility of hazardous waste management firms;
2) Continuity of operations at hazardous waste sites;
3) Contingency plan standards for the hazardous waste industry; and
4) Training and Certification for hazardous waste management employees.

Generally, IR&T played the leading role in Tasks 1 and 2. Dames and Moore played a similar role on Task 3. Task 4 was shared by IR&T and Dames and Moore.

IR&T was given invaluable assistance by Dr. John S. McGuinness of Scotch Plains, New Jersey, a specialist in actuarial science and the insurance industry.

The project director of the study was Lawrence H. de Bivort. Other key IR&T personnel were Charles C. Humpstone, Robert Burt, Polly Neill, James Arnold and Eileen Glennie.

The Dames & Moore principals in charge of this project were Richard C. Tucker and Porter C. Knowles. The following individuals provided key contributions to the various technical areas: F. Larry Doyle, Michael D. Foley, Joseph Fulton, Philip Gagnard, W. Andy Moser, and Patrick Parks.

During the course of the study, numerous interviews took place with representatives of the hazardous waste industry, the insurance and surety industries, U.S. EPA and other government agencies, State environmental departments, various Federal and State insureance corporations, hazardous waste generator firms, trade associations, safety organizations, etc. We wish to thank the many persons who shared their knowledge with us, sometimes in confidence.

Comments, suggestions, or criticisms are most welcome, and may be addressed to:

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INTRODUCTION

The Resource Conservation and Recovery Act of 1976 (RCRA) requires in Section 3004 that the U.S. Environmental Protection Agency (EPA)

> promulgate regulations establishing such performance standards, applicable to owners and operators of facilities for the treatment, storage, or disposal of hazardous waste . . . as may be necessary to protect human health and the environment. Such standards shall include . . . requirements respecting . . . (5) contingency plans for effective action to minimize unanticipated damage from any treatment, storage, or disposal of any such hazardous waste; (6) . . . qualifications as to ownership, continuity of operation, training for personnel, and financial responsibility as may be necessary or desirable . . .

These requirements defined the scope of this study. Four basic tasks were specified: 1) to examine how the standard for financial responsibility might be met; 2) to examine the problems affecting continuity of operations and alternative solutions, including those affecting conditions of ownership; 3) to propose contingency plan standards and examine alternative strategies for implementing the standards; and 4) to evaluate the role of certification in regulating the hazardous waste industry and describe a training program suitable to the industry.

It has always been the case that current generations have had immense impacts on future ones, impacts both helpful and onerous. The balance of each generation's legacy has generally been positive, and so progress from generation to generation has been possible. Recently, side-effects of industrial activity in the twentieth century have raised the possibility that the balance of benefits and burdens to be passed on now may have been significantly altered for the worse. Hazardous waste generation is one of these side-effects. The degree of inherent hazard they present to human health and the environment, the longevity of the hazard in many of the wastes, and the predictability of the process that produces the wastes, pose a fundamental question about the nature of intergenerational responsibilities, rights, and duties. The passage of RCRA Section 3004 provides an initial response to this question. The hazardous waste management industry will be regulated to provide for the long term care of hazardous wastes, in perpetuity if necessary, to minimize the chance of a release of hazardous materials to the environment, to minimize the extent of the release if it should occur, and to provide compensation for damages caused by a release. Inevitably, the regulations required, if these objectives are to be met, will be far reaching and have a direct impact on the development, structure, and financial well-being of the industry.

The hazardous waste management industry is young. It is composed of different groupings that may not have much in common other than the fact that they each handle in some way some wastes that will be defined as hazardous by the assessment protocol being developed by EPA. Upon examining the current hazardous waste industry one is struck by the dissimilarities between its members, rather than the similarities. It is almost more useful to think of it as a number of different industries, rather than a single industry. This view was reflected in the comments made by hazardous waste facility operators during the study.

The hazardous waste industry is fragmented along a number of basic lines. These include:

1) The inherent hazard of the waste materials. Toxics, corrosives, flammables, etc. each present different types of hazards of differing degrees of severity to different types of targets. Hazard will also vary with concentrations. Some hazardous materials will be very hazardous and under the best of conditions represent an ominous threat. Other hazardous wastes maintained under relatively simple conditions may present a threat only under the most unlikely circumstances.

2) The relative hazard of waste sites. Proximity of a site to populated centers, proximity to active mechanisms of transport (such as streams, or acquifers) and proximity to potential sources of site disruption (such as earthquakes, floods, etc.) will effect the relative hazard of a given material.

3) Longevity of the waste hazard. Some materials will maintain a highly hazardous form virtually indefinitely, while others may be neutralized, naturally or deliberately, within very short periods after being generated. Longevities will also be affected by disposal strategy, e.g. incinerator or landfill.

4) Ownership and business context. The industry can be divided into three ownership categories: 1) the "generator-disposers," who are primarily concerned with manufacturing, and only incidentally dispose of their own hazardous wastes, and tend to be relatively large firms; 2) the independent disposers, who are primarily in the business of waste disposal, including hazardous wastes, under contract to waste generators; and 3) public facilities owned by municipalities, counties or States.

5) Technological and financial sophistication. Hazardous waste management firms will have different levels of technological and financial sophistication. The industry has some very up-to-date operators, and some companies with low levels of technology.

6) Hazardous waste operation involved. The industry is composed of those who treat, who store, and who dispose of hazardous wastes. Some only perform one of the functions, others all three.

Each of the variations along each of the lines described here has some significant implication for the ease with which either the financial responsibility or continuity of operations objectives of RCRA 3004 (6) can be met. For instance, a major generator-disposer producing medium hazard level wastes of low longevity should have little difficulty purchasing more than sufficient liability insurance, or providing assurances of continuity of operation. A municipality handling highly toxic materials of long longevity may easily meet continuity requirements, but be incapable of providing proof of financial responsibility.

An incinerator disposer located up wind from a populated area, and handling materials that leave a highly hazardous residue after incineration, may meet all continuity needs but not find liability insurance, while a similar disposer located away from a populated area may meet both objectives with no difficulty.

Economic data on the industry played an important role in this study. It was available in a number of EPA reports, and is summarized below in the terms in which it was used in the study.

Economic Aspects of Hazardous Waste Management

In 1975, the hazardous waste management industry, i.e. those companies disposing of hazardous wastes generated by others, the so-called "off-site disposers," had revenues of 107 million dollars divided among 95 firms. Both revenue and number of firms were subject to a rapid growth in the early 1970's that seems to have leveled off more recently (see Table 1). There were only 110 hazardous waste management facilities, or sites, in 1975, thus the vast majority of firms operated only a single facility. The majority of these facilities are operated by private corporations, partnerships or family operated companies. The remainder are operated by common stock corporations, or divisions or subsidiaries of other large corporations. A limited number of facilities are publicly owned, and these are concentrated in California.

The industry has shown reasonable profits on invested capital (see Table 2), but has shown strong increases in its dependence on debt financing. For those firms whose main objective was hazardous waste management, approximately 40% had working capital deficits in 1975.

Projections of the future of the industry have been quite varied depending on such critical assumptions as the type of regulatory regime, and on the extent to which growth takes place through expansion at present facilities or through creation of new facilities. Foster D.

Table 1
Revenues and Number of Firms in the Hazardous Waste Disposal Industry

	Real Revenues (millions of 1975 dollars)[a]	Number of Firms
1971	59	76
1972	83	82
1973	106	87
1974	113	91
1975	107	95

[a] Current Dollar Revenues converted to 1975 dollars using Business-Non Farm GNP deflator.

Sources: Current Revenues and Number of Firms from Foster D. Snell Inc., Potential for Capacity Creation in the Hazardous Waste Management Industry. Business Non Farm GNP deflator from U.S. Bureau of Economic Analysis, Survey of Current Business.

Table 2

Financial Aspects of the Hazardous Waste Management Industry

	Net Income (millions of dollars)	Total Tangible Assets (millions of dollars)	Total Tangible Equity (millions of dollars)	Return on Tangible Equity (per cent)	Return on Tangible Assets (per cent)	Debt Equity Ratio
1971	4.1	41	19	21.5	10	1.21
1972	3.7	69	30	12.3	5.3	1.30
1973	5.6	77	32	17.5	7.2	1.59
1974	6.6	91	34	19.4	7.2	1.74
1975	7.5	90	33	22.7	8.3	1.64

Source: Foster D. Snell Inc. "Potential for Capacity Creation in the Hazardous Waste Management Industry." (NTIS, Washington, DC 1976)

Snell Inc., in a study for EPA, provided two estimates, one assuming no new regulations and one assuming a stringent regulatory regime requiring the use of environmentally adequate hazardous waste disposal facilities for all hazardous wastes listed as potentially hazardous in EPA sponsored waste assessment studies. The results of these two estimates are shown in Table 3. While the differences in number of facilities and firms is fairly close for these two estimates, the range in revenues (and in turn total capacity) is from 150 to 350 million dollars. A somewhat different approach toward estimating size of the hazardous waste industry was taken in EPA's 1974 Report to Congress on disposal of hazardous waste.* This report assumes virtually no generator-disposers. This assumption is based upon a model demonstrating transportation versus scale economies in hazardous waste disposal for various types of hazardous wastes. This study presents a range of forecasts, two of which are shown in Table 3. The lowest cost is associated with a system having only seven regional multipurpose hazardous waste disposal centers managed by the government. This approach is interesting as representative of a direction toward concentrations that at least some observers of the industry anticipate. It is quite possible that 10 to 20 years from now the vast bulk of hazardous waste disposal may take place in a relatively small number of general purpose facilities. At the other extreme is the high cost estimate associated with a system of 247 small hazardous waste disposal facilities.

This overview of the industry tends to cause one to overlook the enormous diversity of hazardous waste management operations. Virtually excluded from the above discussion are firms whose primary purpose is to engage in specialized types of resource recovery and reclamation operations such as petroleum re-refiners and solvent reclaimers. It is not entirely clear at this time the extent to which such recovery operations are to be included as treaters of hazardous waste, given that the product produced has actual value. Even among those facilities currently classified as hazardous waste management operations, there exists

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*"Report to Congress, Disposal of Hazardous Wastes," EPA, Office of Solid Waste Management Programs (SW-115) (U.S. Government Printing Office, Washington, DC, 1974.)

Table 3

Projections of the Size of the Hazardous Waste Management Industry to 1983

	Foster D. Snell[a] (No new regulations)	Foster D. Snell[a] (stringent Federal regulations)	Report to Congress[b] (small number of national centers)	Report to Congress[b] (large number of facilities)
Revenues (millions of dollars)	150-160	330-350	627	1295
Number of Facilities	130-140	160-170	7	273
Number of Firms	75-85	90-100	-	-

a. Source: Foster D. Snell Inc., "Potential for Capacity Creation in the Hazardous Waste Management Service Industry" (NTIS, Washington, DC, 1976).

b. Source: U.S. EPA, "Report to Congress, Disposal of Hazardous Wastes (SW-115)" (U.S. Government Printing Office, Washington DC, 1974). Revenue estimate is equivalent to cost estimate cited in that Volume.

an enormous variety of sizes and combinations of operations. Some facilities provide only a single simple service such as deep well injection or incineration. At the other extreme are facilities that will accept virtually any type of hazardous waste and provide a broad range of treatment and disposal options within the single facility.

One specific class of facility, the landfill, is of special importance to this study due to the continuity of operations problems it presents. EPA's directory of "off-site" hazardous waste management facilities for 1977 lists 20 secure landfills and 43 landfill lagoons. Among the new facilities called for in the high forecast are approximately 20 new secure landfills.

Hazardous waste sales revenues by firm vary from $35,000 to $12,000,000 per year, with median sales revenues of 1 million dollars per year. Table 4 shows the distribution of sales revenues. Total assets of firms engaged in hazardous waste management varies even more widely, since the industries include small single facility firms as well as branches of such large firms as Monsanto. Conversations with persons knowledgeable about the industry,and the Foster D. Snell projections suggest that both the average size of facilities and the number of facilities per firm will grow as a result of current regulations.

Describing the nature of generator-disposers and determining such general information as the number of sites involved is difficult due to both the enormous diversity of generator-disposers and a number of definitional problems. The first definitional problem is that of the precise definition to be used of hazardous waste. During the period of this study, EPA had not yet defined this term. Studies of potentially hazardous wastes sponsored by EPA have included as hazardous any waste which produces a leachate which is not of drinking water quality. Such a broad definition includes an enormous number of plants now acting as generator-disposers, and probably also covers industries not yet examined by EPA. The second definitional problem lies in the operational definition of the

Table 4

Distribution of Firms Engaged in Hazardous Waste Management by Sales Revenues

1975 Sales Revenues	Percentage of Firms
0-$100,000	19
100,000- 500,000	21
500,000- 1,000,000	15
1,000,000- 2,000,000	31
2,000,000- 5,000,000	10
5,000,000- +	4

Source: Foster D. Snell, Inc., Potential for Equality Creation in the Hazardous Waste Management Service Industry.

legislative term "hazardous waste treatment, disposal or storage facilities." Virtually all hazardous waste generators engage in some degree of treatment, including such processes as sludge dewatering, limited reclamation, and treatment prior to recycling. If treatment is defined sufficiently broadly, then virtually all generators are hazardous waste management facility operators.

Table 5 shows for selected major hazardous waste generation industries the total number of potential generators in the industry, an estimate of the number that engage in either final disposal or long term storage of hazardous wastes (normally in lined lagoons), and an estimate of the total costs to the industry of a high level of control of hazardous wastes. As can be seen, the number of sites involved is enormous, even if sites which engage only in final disposal or long term storage are included.

The economic structure of these industries could not be more diverse. It includes samples of most U.S. manufacturing industries. Included are both industries dominated by Fortune 500 firms, such as primary metals, chemical process industries, and petroleum refining, and industries in which the typical firm is extremely small and total capitalization is extremely low, such as job shop electro-plating.

With these observations on the fragmented nature and economic characteristics of the hazardous waste industry in mind, we turn to our draft report on the four issues that form the basis of this study, how to ensure financial responsibility, how to provide continuity of operations, contingency plan standards, and training and certification.

Table 5

Selected Generator-Disposer Industries

Industry	# of Sites	Estimated Number of Site Engaging in Final Disposal of Long Term Storage [b]	Annual Cost in Millions of Dollars Per Year [a]
Petroleum Refining	247	120	74
Inorganic Chemicals	143	121	20
Organic, Explosives, & Pesticides	2200	1760	243
Metals Smelting & Refining	690	690	31
Textiles	5366	5100	11
Pharmaceuticals	1600	165	9
Electro-Plating	3000-20,000	small number	300-400
Electronic Components Manufacturing	2855	uncertain	20

a. includes costs of off site disposal

b. IRT estimates based upon the sources below, and the summary in Foster D. Snell op. cit.)

Sources: Versar, Inc., Assessment of Industrial Hazardous Waste Practices, Inorganic Chemical Industry. TRW Inc., Assessment of Industrial Hazardous Waste Practices, Organic Chemicals, Pesticides, and Explosives Industries. Battelle, Columbus Laboratories, Assessment of Industrial Hazardous Waste Practices - Electroplating and Metal Finishing Industries. Wapora Inc., Assessment of Industrial Hazardous Waste Practices, Paints Industry. Jacobs Engineering Co., Assessment of Industrial Hazardous Waste Practices, Petroleum Refining. Arthur D. Little, Inc., Hazardous Waste Generation, Treatment and Disposal in the Pharmaceutical Industry. Calspan Corp., Assessment of Industrial Hazardous Waste Practices in the Metal Smelting and Refining Industry. Versar, Inc., Assessment of Industrial Hazardous Waste Practices, Textiles Industry.

Chapter I

FINANCIAL RESPONSIBILITY

A. BACKGROUND

The Resource Conservation and Recovery Act of 1976 (RCRA) provides at Section 3004(6) that EPA "shall promulgate regulations establishing such performance standards . . . as may be necessary to protect human health and the environment . . . (including such) . . . requirements respecting . . . qualifications as to ownership, continuity of operations and financial responsibility as may be necessary or desirable . . . ." The following portion of this report deals with qualifications as to financial responsibility.

The only guidance as to the meaning of "financial responsibility" appearing in the committee reports, especially significant because it accompanied the Senate version which was ultimately adopted, states:

> "One of the specific conditions . . . is the requirement that facilities providing treatment . . . meet minimum qualifications on ownership, financial responsibility, and continuity of operations. In a situation where the best accepted method of dealing with a hazardous waste may be long-term stabilized storage, a permit must contain provisions to assure that the storage site will be maintained over that period. In addition, there must be adequate evidence of financial responsibility, not only for the operation of the site, but also to provide against any liability if the material escapes the storage."[†]

Based on this guidance it appears that by "financial responsibility" Congress meant the ability to pay for injuries to others resulting from escape of hazardous materials.

B. LEVELS OF POTENTIAL LIABILITY

To meet its responsibility EPA must estimate the possible extent of an owner/operator's potential liability and decide to what degree it can and will require the individual firm to insure itself against this potential liability.

[†] "Solid Waste Utilization Act of 1976," Report of the Committee on Public Works, U.S. Senate, to accompany S.3622, June 25, 1976, p. 16.

In order to help estimate potential liability, IR&T reviewed reports of incidents of injury and associated monetary claims arising out of operations of hazardous waste disposal sites or otherwise resulting from improper disposal of such wastes. In doing so it primarily relied upon the recitals of incidents set forth in the House Committee report[Ω], those documented in EPA's own series of reports on the problem[§], from reviewing the current file of newspaper and magazine clippings on the subject maintained by EPA and from a literature search. The information available is for the most part ancedotal and lacking in detail with respect to the actual dollar value of claims paid. It does not yield any statistically valid basis from which to derive reliably the probable range of valid claims or the probable frequency of any given level of liability. It does show the recurring nature of accidents involving hazardous waste disposal under unregulated conditions. Damage claims in the range of $100,000 to $1 million are most common, but there have been several incidents, each resulting in the loss of a single human life, in which the dollar amounts claimed and claims paid, if any, are not reported. Claims involving unintended non-explosive dispersal of non-nuclear hazardous wastes in the United States, although not necessarily as the result of disposal, have led to losses in excess of $4 million. The large number of fragmentary reports of incidents reviewed in the course of this study do provide the factual basis for the short series of composite scenarios set forth in Appendix 6 to this report. These provide background for discussion of hypothetical ranges of loss, but are not based upon statistical analysis of dollar claims or frequency.

[Ω] "Resource Conservation and Recovery Act of 1976," Report of the Committee on Interstate and Foreign Commerce, U.S. House of Representatives on H.R. 14496, September 9, 1976, pp. 17-23.

[§] U.S. Environmental Protection Agency, Office of Solid Waste Management Programs, "Hazardous Waste Disposal Damage Reports," SW-151, December 1975; SW-151.2, June 1975; SW-151.3, May 1976; U.S. Environmental Protection Agency, Report to Congress: Disposal of Hazardous Wastes, SW-115 (OSWMP, 1974), pp. 41-46.

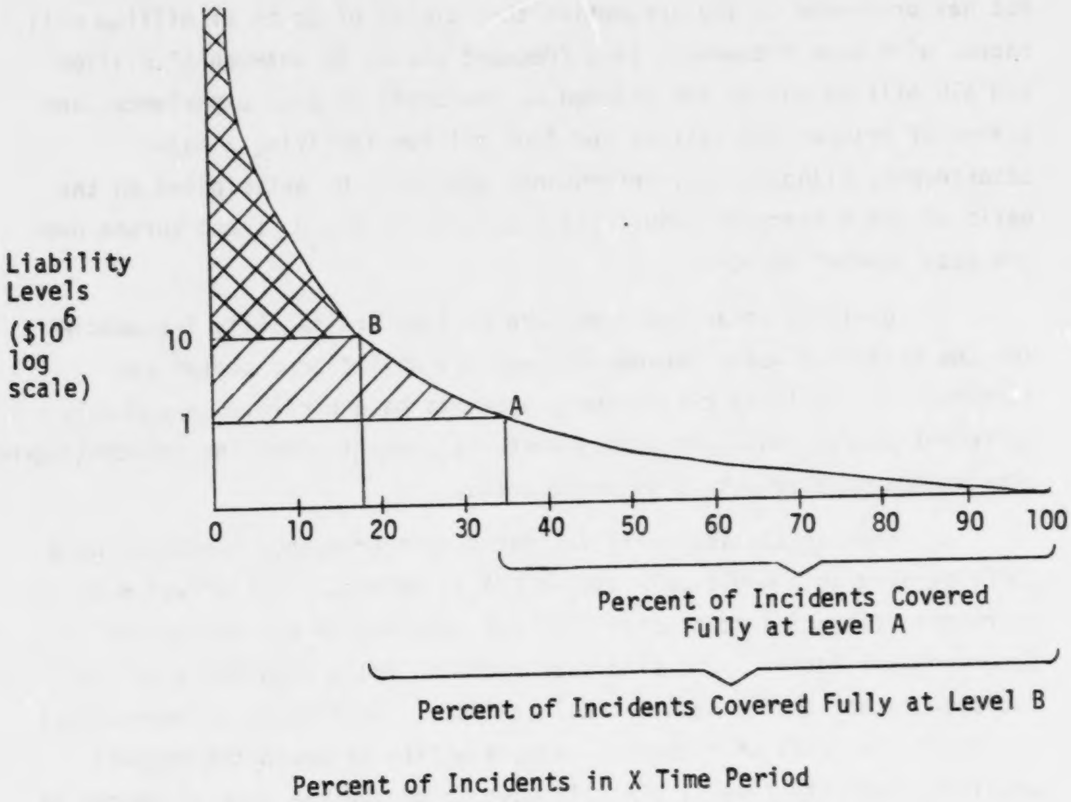
For this reason, this report has not adopted formal estimates, but has proceeded on the assumption that claims of up to $1 million will happen with some frequency, less frequent claims of between $1 million and $10 million may be anticipated on the basis of past experience, and claims of between $10 million and $100 million involving a major catastrophe, although very infrequent, may still be anticipated on the basis of the history of industrial accidents in the U.S. and Europe over the past several decades.

Deriving an accurate measure of loss or liability frequencies for the hazardous waste management industry will depend on two key factors: 1) liability claims and judgements have escalated enormously in recent years, and 2) hazardous waste management operating and contingency plan standards have yet to be implemented.

Even if statistically validated loss frequency functions were to be derived this would only assist EPA in setting a dollar value to represent "financial responsibility" for purposes of satisfying the Congressional intent. Choosing such a dollar value requires a policy decision rather than a mathematical analysis. Because it is impractical to expect the level of financial responsibility to cover the highest possible liability levels, EPA will have to decide the general degree of responsibility it will seek to assure. The nature of the policy decision is shown in Figure 1.

The higher the level of financial responsibility the larger the percent of incidents that will be fully covered. The financial responsibility level decision therefore requires a basic judgement about how much of the total liability to be faced by the hazardous waste management industry will be covered by the mandatory minimum financial responsibility requirement. The degree of protection of human health and the environment afforded by the requirement is balanced by the size of the burden the requirement will place on the industry. The responsibility for providing this protection will not fall solely on EPA's financial responsibility requirement, however. The requirement will establish only a minimum level of protection: the larger companies and the more responsible ones will assess their own potential liability exposures and supplement their

Fig. 1 Hypothetical Liability Frequencies and Financial Responsibility Levels



A. Financial responsibility Level A set at $1 million: 65% of incidents fully covered; coverage up to $1 million for remaining 35% of incidents; total liability not covered in time period shown as ▨

B. Financial responsibility Level B set at $10 million: 82% of incidents fully covered; coverage up to $10 million for remaining 18% of incidents; total liability not covered in time period shown as ▧

NOTE: The available data are insufficient to develop a real liability frequency curve. The hypothetical curve depicted here is an imaginary one, used to illustrate the point that even if such a curve could be constructed the setting of a minimum financial responsibility level would remain a question of policy.

ability to meet the loss beyond the level mandated by EPA. Thus some of the liability area shown as "uncovered" in Figure 1 will be covered at the initiative of the companies with higher loss exposures than the level set by EPA.

At the heart of an insurance program is the classification of the activities to be insured into risk categories. Premium rates, based on loss records and estimates, are established for each category. The hazardous waste management industry is considered a single industry only because of the general function it performs. But, in reality and from the point of view of an insurance program, the industry is made up of many different types of operators, each possessing different risk characteristics. First, there are those who treat wastes, those who store them, and those who dispose of them. Not all companies will carry out each of these functions. Second, some companies will handle all hazardous wastes available; others may specialize in only one type of waste materials. Third, the techniques used by the firms will vary, reflecting such things as the date of purchase, volume of materials, local, state and Federal requirements, and the prior experience of the operator. Fourth, the longevity of the hazard inherent in the wastes will vary widely with the materials being handled; some will become benign in months, others will remain hazardous for thousands of years. And fifth, the location of the site will affect the degree of risk the operation represents. A site located near a town, say, will present a potential loss for greater than one in an isolated locale.

EPA will not be able to set risk levels and financial responsibility requirements for each one of its permit-holders separately. Risk-associated categories may emerge from the permit structure now being developed by EPA, and, over time, the loss records of the industry will form patterns from which the insurance industry will be able to develop risk classifications and premium rate categories. EPA may decide to require a single level of financial responsibility for all its permit holders, on the premise that within a relatively short time the insurance industry will begin to adjust the premiums of the insured operators. Thus while the required level of financial responsibility would continue to be the same for all permit holders, the different degrees of risk that they represented would be reflected in the premium payments.

C. GOALS OF THE OPTIMUM REGULATIONS AND OBSTACLES TO THEIR ACHIEVEMENT

Regulations intended to insure financial responsibility ideally would assure a source of assets, accessible to legal process, that would be sufficient to meet all legitimate claims of damage. These assets should be in a form that claims against them could not be defeated by economic conditions, or the waste disposer's negligence or intentional misconduct. The simplest solution would be for each firm to be required to maintain liability insurance sufficient to meet the largest foreseeable claim. For reasons that will be discussed below, this alternative is not feasible. A second solution would be to have insurance supplied for all hazardous waste disposers by a pool of participating insurance companies. The possible obstacles and alternatives to formation of such a pool are also explored.

The policy decisions that will have to be made by EPA will be of two sorts. First, it must consider whether the costs of the maximum solution (protection against very rare but catastrophic occurrences) are to be built in to the costs of all hazardous waste disposal. Second, it must decide to what degree the non-availability of the optimum solution for most firms now in the hazardous waste business should operate to reduce the regulatory standard. That is, to what degree would it be desirable to give a reduced degree of protection to the public to avoid excluding a large number of the firms, currently in the hazardous waste management business, from further participation?

The principal obstacle to overcome in drafting regulations enhancing "financial responsibility" of hazardous waste disposers is the small size of the current off-site industry and of most of the off-site firms now engaged in the business. As the description of the industry set forth in the Introduction of this report indicates, the industry consists of several kinds of firms. There are between 90 and 100 companies in the contract hazardous waste management business, although some of these obtain most of their revenues from non-hazardous waste disposal. In addition, an unknown number of firms currently dispose of their own hazardous wastes. These firms will be termed generator-disposers. For purposes of this study, the number of generator-disposers expected to continue as generator-disposers under the forthcoming EPA regulations is assumed to be a larger number than the number of companies primarily in the disposal business. No effort was made to estimate the number of such companies or their average revenues. They were assumed to be larger than those primarily in the off-site hazardous waste management business. Of the firms primarily in the waste management business, the median for gross sales revenues is less then $1,000,000 per year. These factors, the small number of participants and the small average size, are the most important limitations to consider in determining regulatory requirements.

The material that follows will consider the most promising of the regulatory opportunities for enhancing financial responsibility. In addressing the question of financial responsibility, the provisions set out by Congress in other environmental legislation were considered. The Federal Water Pollution Control Act provides at § 1321 (p)(1), that any vessel over a given size that might carry oil as hazardous materials in U.S. waters "shall establish and maintain . . . evidence of financial responsibility of $100 per gross ton or $14,000,000, whichever is the lesser, to meet the liability (for clean-up costs incurred by the U.S.) . . .. Financial responsibility may be established by any one of, or a combination of, the following . . .: (a) evidence of insurance, (B) surety bonds, (C) qualifications as a self-insurer, or (D) other evidence of financial responsbility."

The Price-Anderson Act, amending the Atomic Energy Act of 1954, provided under section 170(a) that: "Each license shall . . . have as a condition of the license a requirement that the licensee have and maintain financial protection of such type and in such amounts as the Commission shall require . . . to cover public liability claims."

In practice, EPA and the Nuclear Regulatory Commission have offered to allow, as alternatives to liability insurance, self-insurance in the form of an audited financial statement showing liquid assets sufficient to meet the amount specified in applicable regulations, a letter of credit from a bank, a deposit of securities, a bond, or in the case of water pollution, a guarantee agreement from another company with sufficient liquid assets (usually a parent corporation) to pay the required sum if needed. The NRC usually obtains evidence of liability insurance for most of the liability requirement and accepts one or another of the alternative methods to cover the amount for which the licensee seeks to self-insure itself.

D. ALTERNATIVE METHODS OF MEETING FINANCIAL RESPONSIBILITY OBJECTIVES

1. LIABILITY INSURANCE

The alternative which received the greatest emphasis in this study has been liability insurance. The critical insurance protection for liability from hazardous waste disposal is so-called "non-sudden, non-accidental" coverage. All other liability insurance covers only the consequences of sudden and accidental events such as explosions, pipeline ruptures, or abrupt failure of containment vessels. These risks are common to all industrial facilities working with hazardous materials. The circumstances that are peculiar to hazardous waste management are those that can be associated with such steady-state operations as emission of combustion by-products from incinerators and unintended leaching from landfills. The latter will typically be a slow process in which rainfall or surface water from a stream or pond percolates through previously deposited wastes, dissolving or entraining hazardous materials.

Hazardous waste disposal landfills typically are located above natural or man-made catch basins of impermeable materials. Leakage from such sites would usually result from design error, deterioration of sealing materials, or through unanticipated faults in a natural catch-basin, all non-sudden, accidental events. Only where seismic shock or its equivalent caused fissures through which leakage occurred, would the escape of hazardous material be sudden and accidental.

In general, business organizations in the United States have substantial insurance protection against sudden and accidental releases of materials that cause injury to others.[¶] This had been the traditional standard coverage offered by the insurance industry prior to 1966.

Organizations wanting protection against damage from gradual releases could obtain it at that time, as an optional endorsement, for a modest charge, usually less than five percent of the sudden and accidental release premium. With the industry-wide adoption of the 1966 Comprehensive General Liability (CGL) Standard Policy, this additional coverage ceased to be an option and was included in the standard protection offered to all insurers under their CGL. Erosion of this coverage began during the early 1970's when the insurance industry reacted to the pollution liability potential demonstrated by such events as the Japanese mercury incidents and the proliferation of the state and federal regulatory legislation erecting new standards of performance and due care for industrial insureds. An endorsement excluding damages from contamination or pollution was devised in January of 1971 and widely copied. In 1973, a new CGL standard form institutionalized this change and excluded:

> . . . bodily injury or property damage arising out of the discharge, dispersal, release, or escape of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, liquids or gases, waste materials or irritants, contaminants or pollutants into or upon land, the atmosphere or any water course or body of water; but this exclusion does not apply if such discharge, dispersal, release or escape is sudden and accidental.

Today, standard Comprehensive General Liability policies for non-marine insurance no longer give an industrial organization coverage against claims for damages from gradual leakage or steady-state discharge of pollutants.

This omission from CGL coverage has prompted two organizations to market insurance coverage designed specifically to cover non-sudden non-accidental risks.[**] One of these organizations has ceased to offer the coverage. In addition, a specialized form of such coverage for the most part restricted to the oil industry for drilling and storage of petroleum has been and continues to be available from Lloyds underwriters. Each of these is discussed below.

[¶] See C. Humpstone, "Pollution Insurance Comes of Age," Risk Management, Vol. 24, No. 8, August 1977, pp. 18-21.

The only standardized policy that is currently available has been offered in the United States since 1974 by a syndicate of insurers and re-insurers organized by the London-based firm of H. Clarkson (Overseas) Limited. In the United States, the program is administered on behalf of the syndicate by Howden Agencies, Ltd., of Cranford, New Jersey.[††]

A significant prerequisite for coverage under this policy is an engineering survey made by a surveying firm designated by the insurance group, but paid for by the would-be insured.

The Clarkson's policy provides broad coverage. In its current form, the insurers:

> ". . . agree to indemnify the Insured against all sums which the Insured shall be obligated to pay for damages by reason of the liability imposed on account of:
>
> (a) Personal injury, including death at any time resulting therefrom;
>
> (b) Property damage;
>
> (c) Impairment of, diminution of, or other interference with, any other environmental right or amenity protected by law;
>
> . . . caused by Environmental Impairment . . ."

[**] There exists some confusion over the use of the terms "accidental" and "non-accidental." A non-accidental release, a release that is a known part of the process, may cause unintended damage. This type of non-accidental release is insurable. If the damage itself is predictable or intentional, however, the event is not insurable.

[††] The information on the policy is drawn from staff interviews with Mr. Bernard Daenzer, President, and Mr. Walter Foster, Senior Vice President, of Howden Agencies, Ltd.

Environmental Impairment is then defined as:

(a) The emission, discharge, dispersal, disposal, seepage, release or escape of any liquid, solid, gaseous or thermal irritant, contaminant or pollutant into or upon land, the atmosphere or any water course or body of water;

(b) The generation of smell, noises, vibrations, light, electricity, radiation, changes in temperature or any other sensory phenomena.

This policy also covers costs of litigation and clean-up costs, whether incurred under a legal obligation or in an effort to avert loss under the policy. As currently administered, the policy contains limitations of $4 million on payments for any one claim and $8 million on total claims during a given period of insurance, usually one year. It provides "claims made" coverage, that is, coverage for any claims made during the year regardless of when the event upon which the claims are based took place (as contrasted with "occurrence" insurance which covers events taking place during the term of the policy). Reduced premiums are available based on alternative deductible options.

The policy excludes some causes of liability absolutely; others are only provisionally excluded. The absolute exclusions are specified nuclear risks, workman's compensation and environmental impairment resulting from knowingly failing to comply with applicable regulatory requirements unless a temporary variance has been granted permitting noncompliance for a limited time. There is also an absolute exclusion covering fines, penalties and punitive damages.

The provisional exclusions include environmental impairment involving a sudden, unintended and unexpected happening, genetic damage, damage to the insured's property or property in his care, custody or control, and joint or several liability with others. The policy permits deletion of one or more of these exclusions for an additional premium.

As of the writing of this report, inquiries about the insurance had been made on behalf of three large hazardous waste disposal firms, and one small firm that disposes of electric power plant fly ash. The fly ash disposer and one of the hazardous waste disposers had been surveyed and had purchased the insurance; another large disposer was in the process of being surveyed.

The second non-sudden, non-accidental policy was marketed by Excess Underwriters, Inc. of Chicago for approximately 18 months ending in mid-1976, when it was dropped for apparent lack of a market for its coverage.[ΩΩ]

Although no longer offered, it is discussed here because its terms and the restrictions placed on its availability may be helpful as indications of the insurance industry's possible responses to EPA regulations promulgated under RCRA 3004(6). The coverage was marketed as the "Environmental Protector Liability Insurance Program." It required that the insured be in compliance with applicable regulatory standards. It covered personal injury and property damage caused by "seeping pollution or contamination which is not a sudden or accidental happening . . . ." Like the Clarkson's policy, it did not insure against fines or civil penalities, only against liability for injury. It differed from the Clarkson's policy in that it provided "occurrence" rather than "claims-made" coverage. The distinction is significant: an occurrence policy covers a liability, regardless of when it arises, if the event causing it took place during the term of the policy. Under an occurrence policy, with a one-year term effective January 1, 1972, a leak that drained a catch basin during 1972 would be covered even though the leakage did not contaminate a neighbor's water supply until 1977. A 1972 one-year claims-made policy would cover only a claim made during 1972, regardless of when the event causing the injury took place.

[ΩΩ] Information on the Excess Underwriter's policy was obtained through correspondence and a telephone conversation of July 5, 1977 with Mr. John Van Cleave, Senior Vice President, Excess Underwriters, Inc.

The Excess Underwriter's policy also differed from Clarkson's in that it required execution of a much more detailed questionnaire describing operations and effluents, pre-insurance "certification" by a pollution control engineer, and subsequent audit by an environmental control engineer at the insured's expense. The insured was also required to adopt any recommendations for emission controls made as a result of the audit as a condition of maintaining coverage. Promotional material describing the policy included the statement:

> "As an additional assist to you in evaluating your clients acceptability, the following industries will not be eligible, unless full compliance is possible:
>
> Electric power generation
>
> Fruit and vegetable canning and freezing
>
> Steel production
>
> Paper and pulp mills.

Since the policy stated elsewhere that it was available only to facilities operating in compliance with applicable regulations, this statement suggested a high degree of insurer anxiety even over risks with relatively low hazard (although voluminous and widely publicized) waste streams. This anxiety would have direct bearing on the availability of non-sudden, non-accidental coverage for hazardous waste disposers. Excess Underwriters, Inc. has indicated that it believes the activity is too hazardous to obtain commercial insurance coverage and that government participation would be a necessary element if there is to be effective insurance coverage.

The only other standard type of policy extending coverage to non-sudden and non-accidental steady-state releases is the Lloyds policy referred to above. This insurance, entitled "Seepage, Pollution and Contamination Insurance," was developed by Lloyds Underwriters to cover oil drilling and storage. In its simplest form it covers "seepage, pollution or contamination" which, without further clarification, appear to be non-sudden and non-accidental events. An option is available, at increased premiums, to cover "sudden unintentional and unexpected happenings." The policy is similar to the two described above in that it covers liability for injury to persons or property, but not criminal fines or penalties. Like the others, it covers cost of clean-up and litigation. Also like the other two, it requires that the insured be in compliance with applicable regulatory standards. It differs principally in that it does not require a pre-insurance audit, but requires instead that the insured permit the underwriters to inspect the insured's premises during the term of the insurance.

As noted above, this policy is one of the standard policies written by Lloyd's underwriters, but ordinarily only applied to the oil industry. While its terms do not expressly limit it to oil, the wording of several paragraphs indicates its common application, e.g., paragraph 7:

> "If during the period of this Policy the insured drills any additional wells, Underwriters agree to cover such additional wells . . . ,"

and paragraph 8(d):

> "This Policy does not cover the cost of controlling a well nor the cost of drilling relief wells whether or not the relief well be successful."

Although this non-sudden and non-accidental coverage could theoretically be extended to any policy written by a Lloyd's underwriter, in practice Lloyd's underwriters, when insuring a risk in the United States, typically follow the terms of the standard U.S. CGL policy described above. There can be exceptions to that practice. Lloyd's underwriters are free to construct custom-designed coverage for any risk they care to insure. Called "manuscript policies," these can contain a variety of non-standard provisions. If a major purchaser of insurance asked to have provisions similar to the oil seepage, pollution and contamination language added to his policy, the Lloyd's underwriter might be willing to cooperate. In general, however, the insuring of oil drilling operations is a highly specialized activity; the organizations which do it specialize in it, and there is little exchange of information between them and the general insurance community. For this reason, a broker seeking to obtain non-sudden and non-accidental coverage for a hazardous waste disposer would not ordinarily learn of the possible availability of this Lloyd's coverage.

In addition to these standard forms of insurance, other insurers are also allowed to write so-called "manuscript" or custom-designed policies to cover their client's special insurance needs. Non-sudden and non-accidental pollution insurance could be written into such policies, although in practice this type of coverage is rare.

Recent developments in state law may change the availability of non-sudden coverage. Kansas has recently amended its waste disposal law to provide that hazardous waste disposal firms must obtain liability insurance "including coverage against non-sudden occurrences. . . ."[§§] The one waste disposer currently complying with the Kansas Statute has obtained the necessary coverage from the Hartford Insurance Company.

A recent amendment to New York law prohibits the issuance of non-sudden, non-accidental coverage in that state, except where required to meet financial responsibility requirements of New York and Federal law. It provides:

> The kinds of insurance which may be authorized in this state, subject to the other provisions of this charter, are set forth in the following paragraphs . . .,
>
> * * *
>
> 13. Personal injury liability insurance . . . policies, except those purchased to satisfy the financial responsibility requirements for any federal law . . . issued to commercial or industrial enterprises providing insurance against the legal liabilities specified in this subdivision shall expressly exclude therefrom liability arising out of pollution or contamination caused by the discharge, dispersal, release, or escape of any pollutants, irritants or contaminants into or upon land, the atmosphere or any water course or body of water unless such discharge, dispersal, release or escape is sudden and accidental."[¶¶]

[§§] Kansas Statutes Annotated, 1976, Supp. 65-3407.

[¶¶] McKinney's Consolidated Laws of New York, Title 27 Insurance Law, §46.

A similar provision applies to property damage liability insurance. These sections suggest a legislative hostility to pollution insurance presumably resting on a concern that such insurance could have the effect of a license to pollute, enabling the polluter to pass along the cost of premiums to his customers.

It is not clear to what extent enactment of these provisions reflected lobbying efforts by industry representatives seeking to obtain legislative protection against current judicial inroads into the restrictive language currently written into the standard CGL coverage. Although no examination of case law was undertaken in this study, nearly every insurance company official or representative of an insurance industry trade organization contacted during this study commented on the increasing willingness of courts to override the non-sudden and non-accidental exclusionary language. The focus of the controversy lies in the judicial tradition that ambiguities in insurance contracts are construed against the interests of the insurer. In one case, for example, gasoline from a storage tank leaked into a municipal sewage system over an extended period of time before the gasoline fumes exploded, causing property damage. The court held that the occurrence insured against was the explosion rather than the leakage.

This judicial trend has several consequences for the anticipated RCRA §3004(6) regulations. Some insurance companies are seeking to strengthen the exclusionary effect of the present CGL wording by litigating all claims involving non-sudden, non-accidental elements. Their position is mirrored in the new New York statute. Other companies have shown a willingness to abandon the exclusion in the face of judicial determination to weaken it. These companies make a practice of paying otherwise meritorious claims without litigating the distinction between non-sudden and sudden events. At present, several insurance company representatives, acting under the aegis of an industry-wide organization, are in the process of drafting language to supplant the existing CGL exclusion in the expectation that broader coverage eliminating the distinction between sudden and non-sudden, but not that between accidental and non-accidental, will return to more general acceptance.

In order to estimate the availability of ordinary CGL coverage for hazardous waste firms, senior representatives of major insurance companies were asked for their opinions as to the availability of such insurance for such firms. The concensus of opinion was that a hazardous waste disposer with annual sales of $500,000, perhaps with some difficulty, would be able to obtain ordinary CGL coverage for up to $1 million in liability. A larger firm with sales in the million to several million dollar range might be able to obtain coverage of up to $5 million. Larger organizations with sales in the tens of millions should be able to obtain liability coverage of between five and ten million dollars. The largest organizations in the industry and many large generator-disposers will be able to obtain liability coverage of $50-100 million. In many, perhaps most, cases where more than a million dollars worth of coverage is involved, several firms will be involved: a primary insurer and one or more re-insurers.

In general, the industry representatives see no limitation in the capacity of the insurance industry to provide coverage at these levels for well managed firms operating within strict EPA regulations. The difficulty would come if the regulatory process were to impose a standard liability amount greater than the scale suggested above. As total liability figures increase, insurance companies prefer to see substantial increases in "retention". Retention is that portion of a policy defining the dollar level up to which the insured will pay itself rather than seek payment from its insurer, similar to the deductable limits in automobile liability policies. If, for example, following the oil spill precedent, a $15 million liability requirement were imposed, the insurance industry might not be willing to provide such coverage to any but the very largest integrated chemical companies disposing of their own wastes, because satisfactory retention levels might not be possible.

2. TRUST FUNDS

As an alternative to traditional liability insurance, the feasibility of regulations contemplating the formation of one or more trust funds was examined. The proposed trust fund would have been financed out of contributions from hazardous waste disposers and administered by a fiduciary organization formed for the purpose. Its role would have been to accumulate contributions, invest its funds, and pay meritorious claims against participating waste disposers.

The investigation disclosed two shortcomings with this approach, one of which appears to eliminate it from further consideration. The first of these drawbacks, the narrow financial base upon which such a trust fund would rest during its initial years, would not eliminate trust funds from consideration, but would only partially assure financial responsibility. Assuming that contributions were comparable to the level of CGL insurance premiums that participating waste disposers would have to pay for conventional liability insurance if available, the fund would not have either the capital base or the diversification that would ensure adequate funds to pay foreseeable claims. However, if no major claims arose, over a period of years a large financial reservoir would eventually accumulate that would provide the necessary resources to meet large claims.

The second major drawback affects many states and does not appear to have a solution. The insurance laws of many states contain express prohibitions against any organization providing insurance or services analogous to insurance unless it is a fully qualified insurance company.[***] The closest analogy to the proposed waste management trust fund examined during the study was the special trust fund established by the New York Stock Exchange in 1964. After several decades of prosperity, during which no member firms failed, one went bankrupt in 1959. The Board of Directors of the Exchange decided to apy the firm's losses of approximately $900,000 so that no member of the public would be injured. In 1963 a much larger firm failed as a result of the so-called "salad oil" scandal. The

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[***] See e.g. McKinney's Consolidated Laws of New York, Title 27, Insurance Law, §§40, 40; Deerings California Code, §700. Other states, such as New Jersey, allow trusts to provide insurance to its participants, in effect the equivalent of self-insurance. Were it not for the first shortcoming of the trust approach it might be one way to meet EPA objectives in those states that allow the arrangement.

Exchange again assessed its members to pay the resulting $27 million deficit. To avoid the imposition of such large ad hoc assessments, the Exchange amended its constitution to provide for a trust fund, to be administered by its directors, for the purpose of providing assistance to customers of insolvent or failing member firms. In the years following 1964 the fund paid out approximately $90 million to customers, and, in fact, paid every eligible customer of every insolvent member firm. It became inactive when Congress enacted Federal legislation creating a Federal insurance corporation, similar to the Federal Deposit Insurance Corporation, to extend similar coverage to customers of all exchanges.

Because of the state laws prohibiting the furnishing of insurance by other than a qualified insurance company, the terms of the trust, from its inception, provided:

> "Whether or not expenditures from the Fund shall be made in any particular case and, if so, in what manner, to whom and to what extent, shall at all times remain exclusively within the sole and absolute discretion of the trustees of the Special Trust Fund."

Although applicants for hazardous waste management permits might be required to belong to an organization operating a similar trust fund, as a condition of obtaining their permits, its existance would not necessarily furnish the assurance of financial responsibility required by RCRA, if because of state law such an organization would have to operate without any legal obligation to pay. Also, the creation of such an optional payment trust would appear to create a potential opportunity for financial abuse that would be difficult for EPA to prevent.

3. CAPTIVE INSURER

There is a possibility that hazardous waste management operators may choose to set up a "captive" insurer, an insurance company established specifically to meet their needs. This would require reinsurance, in effect providing the regular insurers with a uniform deductible or retention level above which their coverage could take effect. The advantage of this alternative is that the particpating operators could share, on a reciprocal basis, responsibility for meeting losses up to the amount of the retention. As a result of this risk sharing, the capital requirements of a reciprocal captive insurer can be quite modest. A further advantage is that the profits of the insurer, which would accrue if the loss record of the participating operator were lower than expected, would benefit the insureds through their ownership of the insurer.

4. INSURANCE POOL

The most promising of the opportunities for ensuring financial responsibility is an insurance pool. Such a pool, if the insurance industry could be encouraged to form one, would consist of a joint undertaking by a number of insurance companies to participate in meeting claims against hazardous waste managers buying insurance from it. Participating insurance companies could determine, in advance of joining, the percentage of the total risk each would be willing to accept. Such pools exist for liabilities associated with nuclear hazards, marine oil spills, aviation accidents, and similar high-risk activities. The advantage of a pool from the insurers' point of view is that it provides a convenient mechanism whereby a large number of insurers can each be responsible for only a small fraction of the risk. It overcomes the insurance law prohibitions that would exclude trust funds because the participants would be fully qualified as insurance companies. The advantage from the insureds point of view would be that the pool would be familiar with waste hazards, knowledgeable about disposal technology, and able to make an informed decision whether to underwrite and what premium to charge.

There are substantial obstacles to the formation of an insurance pool to cover hazardous waste disposers. Although EPA may have the regulatory power to deny a permit to any hazardous waste manager who does not insure through such a pool, it does not have the authority to compel insurance companies to form one. The insurance industry in the United States has suffered a succession of heavy losses over several years arising out of products liability, medical malpractice liability, and automobile operators liability insurance. The industry is in the process of attempting to reduce its exposure to high risk liability in which there is a potential for very large claims. The industry representatives contacted in the course of this study were all, in some degree, skeptical that insurance companies would be willing to form a pool to deal with a new set of major risks at this time. There was, however, some difference of opinion among the individuals interviewed over the probable degree of unwillingness. Some felt that the industry would form a pool although somewhat reluctantly, partly out of a sense of collective responsibility for meeting such problems, partly to discourage legislature resulting in the further entry of the Federal government into the role of insurer.

A number of individuals interviewed volunteered suggestions concerning circumstances that would operate to increase or decrease the attractiveness of participation in a pool. There were repeated cautions against the pool being forced by government pressure into the role of accepting assigned risks.

"Assigned risk" in this context means a hazardous waste manager whose operation, because of its financial condition or operating record, would not be acceptable to the pool. In a number of states, insurance companies have been by statute prohibited from writing any insurance of a particular kind unless willing to participate in extending coverage to a pool of assigned risks not otherwise acceptable as insureds. Industry representatives asserted that every assigned risk pool loses money for the participating insurance companies because the rate fixing process always lags behind the loss experience. The industry is also wary of being put in the position of having to pay for injury resulting from behavior that should be prevented by exercise of the government's regulatory standards, but which the government for political reasons is unwilling to prevent. The suggestion was made that the financial responsibility regulations not attempt to establish the characteristics of an acceptable insurance pool in such a way as to require the pool to accept all EPA permit applicants.

A second caution was extended against any procedure that resulted in a "selection against" the insurers. In this context, "selection against" means eliminating the lowest risk potential participants from a pool in such a way that the remaining participants are all in the highest risk category. This kind of selection process could be expected if the regulated group were free to select among alternative methods of establishing financial responsibility and the low risk participants were eligible to establish financial responsibility by less expensive alternatives then participation in the pool. This, for example, would be the case if major generator-disposers were permitted to file audited statements showing the availability of liquid assets sufficient to meet a specified liability figure, instead of joining the pool.

5. SELF INSURANCE

The precedents of the oil spill and nuclear financial responsibility regulations are useful to review in evaluating methods of assuring financial responsibility that do not involve insurance. The most frequently used alternative in meeting the oil spill $15 million requirement and in meeting the $5 million self-insurance portion of the nuclear financial responsibility requirement is the filing of a special auditor's report showing that the permit applicant has adequate resources to provide the required financial protection. In practice this has meant net current or liquid assets equal to the required dollar amount. For a firm with sufficient assets, the accountant's charges for preparing such a report are always significantly less than insurance premiums for a liability policy in the same amount. For smaller firms, of course, this alternative is not available. In the hazardous waste management field, this alternative would be available, depending on the liability coverage chosen by EPA, to only a few of the present off-site waste disposers, but to an important fraction of the large generator-disposer. A variant on the filing of the company's own financial statement allowed by the oil spill regulations is the filing of a guarantee agreement from another company together with the financial statements of the guarantor company. State insurance laws are usually interpreted as permitting an isolated guarantee by a company of an affiliate's performance without violating prohibitions against insurance activities.

6. POSTING OF COLLATERAL

The oil spill regulations (wnich contemplate that payment will be from the permit holder to the Government for its clean-up costs) also permit filing of an irrevocable letter of credit from an acceptable bank. The alternative is seldom, if ever, used. Obtaining a letter of credit is, in practice, very much like obtaining a loan. Where the liquid assets of the company seeking the letter are insufficient to repay it on demand, the bank will typically seek collateral equal in value to the required letter.

The oil spill regulations also permit the permit applicant to deposit suitable securities equal in value to the required amount. The drawbacks of these two methods will be similar. Each requires the permit applicant to produce very large amounts of liquid assets. These will not be available to small firms. Large firms will be reluctant to divert liquid assets into a static and unproductive function, and will prefer to pay the operating costs associated with certification of financial condition or the premiums on liability insurance.

7. BONDING

The portion of this report dealing with continuity of operation discusses, in some detail, the nature and availability of bonds as a device for assuring that specified responsibilities are met. Insofar as assuring financial responsibility to withstand large liability claims is concerned, bonding is not among the feasible alternatives. A summary of the opinions given by representatives of major bonding companies and by a national trade organization of such companies will indicate why.

Bonding is not perceived by surety companies as a form of insurance. It is a certification service. It consists of an evaluation by the surety company that the bond applicant will be able to perform a stipulated activity. Bonds are never written on the assumptions that the stipulated responsibility will not be fulfilled. The premiums on bonds are not intended to accumulate as a reserve against the anticipated responsibility not being carried out. Instead they are intended to cover the cost of the evaluation process by which the surety determines that the company seeking the bond will, in fact, be able to carry out the stipulated responsibility. Bond premiums are often but not always a small fraction of what liability insurance for the same amount would be. When a bonded firm defaults on its obligation, unlike a liability insurer, a surety expects to recover whatever it pays out under the bond from the firm. In many cases, where the stipulated activity involves financial responsibility, the bondsman requires up to 100 percent collateral to secure the bond. Where less than 100 percent collateral is required, the surety must be satisfied that the firm's net liquid assets are sufficient to meet the obligation. Although a surety will consider other assets than cash and marketable securities, it requires assets that can be realized upon with a minimum of delay. Typically, land and equipment are not considered satisfactory assets for this purpose.

Finally, an important distinction between bonding and liability insurance is that a bond is usually held by the entity that will bear the initial injury if the condition of the bond is not fulfilled. In the case of the oil spill clean-up on the typical contractors completion bond, the Government agency that will have to absorb the initial costs of non-performance holds the bond and recovers on it from the bonding company in case of default. In the case of liability for injury of persons or property resulting from hazardous waste disposal operations, it is not possible to determine in advance who would be injured. The Government or some other identifiable institution would have to accept the role of the obligee and undertake to pay all meritorious claims wherever any bonding mechanism is to be utilized.

E. POST-CLOSURE FINANCIAL RESPONSIBILITY

The foregoing discussion presupposes the participation of a current permit holder or applicant. Under some circumstances there may be injury but no permit. During the operation of a site there will always be a permit holder to whom injured persons may look for indemnification. After a site has been closed, however, there is an increased likelihood that the former operator, although legally responsible for post-closure monitoring and maintenance and in meeting financial responsibility requirements, may default in these responsibilities. So long as a permit holder is currently operating other sites, for which it requires a permit, there is no difficulty in requiring continued compliance with financial responsibility standards. If, however, the closed site is a business's only hazardous waste disposal activity, there will be an increasing financial incentive to abandon it by allowing the permit-holding organization to go out of business. There will also be organizations going out of business for valid financial reasons.

The following chapter on continuity of operations deals with ways of assuring that even in such situations, the costs and responsibilities of closing and carrying out necessary post-closure maintenance and monitoring can be met. This section will anticipate the application of the same or similar mechanisms to the post-closure financial responsibility requirements.

The underlying problem is that under the hypothetical but foreseeable circumstances identified above, there would be no permit holder to pay liability insurance premiums or otherwise meet financial responsibility requirements. Insurance premiums, whether paid to an individual insurance company or to an insurance pool and whether applied to a policy written on an occurrence or a claims-made basis, typically run for a specified period, usually one year. It therefore would be necessary to assure the continued existence of a source of funding to meet future premium costs. These costs would be more in the range of monitoring costs and maintenance, i.e., $10 thousand to $100 thousand per year, than in the range of potential liability costs.

There are several ways such a fund could be created. These are discussed in detail in the chapter on continuity of operations and will be summarized here.

Common Premium Trust Fund or Assessment -- Permit holders could be obligated to belong to an organization that would collect annual payments based on members' revenues and hold them in a common trust fund to meet the possible future need to pay premiums for any defaulting members. Alternatively, the Federal Government or cognizant state governments could hold the fund. Such a fund, whether separately identified or incorporated into a larger trust fund intended to meet other post-closure costs,would need to be only relatively small. During its initial years of accumulation, it might have no premiums to pay at all. Even after several firms had defaulted, the pro-rata premium costs per default per year (assuming $100 thousand per year premiums for each defaulter and 200 members) could be modest. Because these costs might be so low, funding them in advance might not be necessary. At least until a significant number of firms had defaulted, it might be preferable to simply assess member firms to pay subsequent premium costs whenever a default occurred.

The shortcoming of such a trust fund or assessment procedure would be that responsible members would be sharing costs that properly should be borne by the defaulters alone. The alternative procedure described next avoids this problem, but raises others: administrative complexity and excessive governmental involvement in business operations.

Prepayment and Refund of Post-Closure Costs -- Instead of joint participation in a collective remedy, permit holders could be required to make payments out of current revenues from a specific site into an account held by the government or an escrow agent identified with the particular post-closure obligations of the individual permit holder. Such an account would accumulate during the operation of the site. Closure costs expended by the permit holder would then be repaid to him out of the fund. The fund would be designed to be large enough so that post-closure costs could be met out of interest on the remaining principal. Insurance premiums, in the case of a continuing business, would be paid in the first instance by the permit holder and reimbursed to him by the fund. In the case of a default, the government or other escrow agent could pay the premiums directly.

The process of accumulating a large fund and reimbursing an operator from what were originally his own revenues, seems an extremely cumbersome one. It holds promise of disputes in which the operator claims larger amounts for closure costs or post-closure operations than EPA deems reasonable. It presupposes that the governmental entity or escrow holder is a more reliable custodian of the funds than the waste disposer and depletes the operator's available operating capital requiring him to pay the additional costs of obtaining substitute capital.

Under the circumstances, EPA may find that regulations imposing assessments or joint financial responsibility premium costs on non-defaulting operators, however inequitable, may be preferred by the operators as an inherently less expensive and less burdensome means to assure long-term funding of liability insurance premiums.

F. SUMMARY OF ALTERNATIVES TO PROVIDE FINANCIAL RESPONSIBILITY

Liability Levels -- Examination of data on recent damage incidents indicates that there is no reliable classification process by which the relative hazards from differing waste storage, treatment and disposal processes (e.g., incineration, land fill, deep well injection, or the like) can be established. The dollar value of damages in the reports reviewed ranged from $100,000 to $4 million. Large industrial organizations sometimes carry liability insurance of up to $100 million or more.

Availability of Conventional Liability Insurance -- Large firms will be able to obtain insurance coverage against sudden and accidental occurrences in the range of $5 million to $10 million. Very large organizations, able to absorb retentions of $500,000 to $1 million, will be able to obtain liability insurance aggregating $50 million to $100 million. Most contract hazardous waste disposers, with annual sales of $500,000 or less, will be able to obtain coverage of $1 million, but will have some difficulty in doing so. Availability of non-sudden coverage is more speculative. One insurance group offers such coverage up to $4 million per claim. A major insurance company is willing to provide such coverage under a manuscript policy where it is required by state law. There is a tendency in judicial opinions to minimize the sudden/non-sudden distinction. There is some industry support for eliminating it.

Availability of an Insurance Pool -- Given sufficient EPA encouragement, and regulations that require participation by all firms including major on-site disposers, the insurance industry may be willing to form an insurance pool. Such a pool, if formed, would probably be willing to offer pool-wide coverage of $10 million and might be willing to offer between $50 and $100 million, if not initially, perhaps after some accumulation of premiums and of loss experience data. A pool would be less likely to form if there is a strong likelihood that it will be required to accept assigned risks.

Trust Funds -- State insurance laws may prohibit the substitution of a jointly financed liability fund in place of conventional liability insurance offered by authorized insurance companies or a pool of such companies.

Self Insurance -- Only the largest industrial organizations will be able to demonstrate the ability to self-insure in the contemplated range of liability values. As indicated above, elimination of these companies from inclusion in a potential insurance pool would almost certainly jeopardize the formation of such a pool.

Posting of Collateral -- Only very large organizations could afford to post collateral in the amounts contemplated. Even organizations with adequate resources would be very reluctant to do so.

Bonding -- Payment of damages from accidents would be an inappropriate use of the surety bonding mechanism. Bonding companies would be unwilling to issue bonds without full collateral or proof of a disposer's ability to pay equal to the amount of the bond. Use of the bonding mechanism would require regulatory creation of a requirement that EPA, or a designated stakeholder, be responsible for paying all meritorious claims out of the proceeds of the bond.

Post-Closure Financial Responsibility -- Promises must be made to pay premiums on liability insurance, even for an indefinite period, for firms that abandon sites, go out of business, or otherwise become unable to meet the financial responsibility requirements. Permit holders could be required to make small payments into a fund from which insurance premiums on abandoned sites could be met or to agree to be assessed for pro-rata payment of such premiums as they come due. Alternatively, a fund for each permit holder could be held by the government or by an escrow agent in connection with the payment of closure and other post-closure costs, large enough so that interest on the fund could meet premium costs. Where the permit holder did not default it could be reimbursed for closure and post-closure costs out of the fund. Although the joint fund or assessment would transfer the defaulter's costs to non-defaulting permit holders, they might prefer bearing those costs rather than the costs of the individual account coupled with the complexity implicit in its refund mechanism.

G. ECONOMIC ASPECTS OF FINANCIAL RESPONSIBILITY REQUIREMENTS

This section illustrates certain economic advantages and disadvantages associated with various means of meeting financial responsibility requirements. The first step in this exercise ideally would be a set of statistical frequencies and associated liability levels for various possible hazardous waste related accidents. As already noted, however, current data do not permit any statistically sound acturarial estimates of frequency of accidents associated with hazardous waste management facilities as they will be operated with forthcoming RCRA Title C regulations. This is due both to the absence of a thorough accident file and to the relatively brief experience to date with environmentally adequate hazardous waste management facilities. It should be noted that the available data indicate that major liability claims are relatively scarce. The data gathered also do not record a single instance of a major liability claim against an environmentally adequate hazardous waste disposal site. Depending upon the exact definition of environmentally adequate, there has been a minimum of 150 to 450 site years of experience at environmentally adequate hazardous waste management facilities.

In order to illustrate the economic features of various options for meeting financial responsibility requirements, it is necessary to use some estimate of frequency of liability claims. For this purpose, four possible sets of liability frequencies were constructed, and are shown in Table 6. These liability frequency tables are a judgement estimate from existing data and discussions of possible accidents in hazardous waste

Table 6

Hypothetical Frequencies for Various Levels of Liability

	Frequency in Events per Site Year						Expected Value Per Site Per Year
	1/100	1/500	1/1000	1/2500	1/5000	1/10,000	
Liability Frequency Set #1		$ 100,000	$ 500,000		$ 1,000,000	$ 10,000,000	$ 1,900
Liability Frequency Set #2	$100,000	500,000	1,000,000		10,000,000	100,000,000	15,000
Liability Freuqency Set #3	250,000		10,000,000	$100,000,000		200,000,000	56,500
Liability Frequency Set #4	250,000	10,000,000	100,000,000				122,500

facilities with a variety of individuals. They are therefore, primarily illustrative and do not represent sound actuarial estimates. It could well happen that the eventual frequencies lie outside even the broad bounds shown by these liability frequency sets. The sets assume progressively greater frequencies of accidents involving large liabilities. The first might be considered to correspond to the estimates implicitly associated with the relatively low liability requirement set by some states. The fourth represents the assumption of an extremely high-risk industry.

Associated with each liability frequency set is an expected value. This number is equal to the frequency of a claim times the level of liability. It may be thought of as the average cost per year numerically equivalent to the cost of occasional accidents. These expected values range from $2,000 per year to $122,500 per year. If the liability frequency given is accurate, then the expected values represent average costs per year that will be incurred by someone as a result of accidents at a single hazardous waste management site.

In dealing with relatively remote events, it is important to remember that even extremely unlikely events occur. Table 7 provides a simple illustration of this point. Even if there are only 150 hazardous waste management sites, it is highly probable that events of a frequency of as low as 1 per 1000 site years of operation will occur over the next twenty years and at least a one in four chance that events as rare as one in 10,000 site years of operation will occur.

Insurance

The simplest and most conventional method of dealing with potentially large liability problems is insurance. In order to clarify the possible cost of insurance, we first examine the cost of various levels of coverage will be examined first, assuming the above liability frequency sets represent actuarial probabilities that might be used by insurance companies. The problem of whether hazardous waste management facilities can be considered to be insurable risks will then be taken up briefly, as well as

Table 7

Probability that Events with a Given Frequency will Occur within 20 Years in an Industry Consisting of 150 Sites

Frequency (incidents per site-year of operation)[a]	Probability that at least one such incident will occur
1/100	.9999
1/500	.998
1/1000	.95
1/2500	.70
1/5000	.45
1/10,000	.26

Derivation: If events follow a Poissin Distribution then the formula for the probability of at least one event over a given level of set of experience is 1-expl-ft where f is the frequency and t is the number of site years of experience.

[a] A site year is defined as 1 year of operation at one site.

mechanisms insurance companies might use to overcome the lack of a statistically sound actuarial basis for computing premiums. Table 8 shows premium levels by liability set and by levels of maximum coverage. It should be carefully noted that these premium levels are intended to represent solely premiums for insurance against liability due to exposure to hazardous wastes by persons other than employees and to property. Also excluded are exposures that result from transporting hazardous wastes. These premiums are not intended to represent the costs of other general liability coverage, or the cost of umbrella coverage, and do not include workman's compensation insurance costs. Premium levels are calculated assuming that actual liability payments constitute 70 percent of the cost of insurance coverage. This is consistent with major fire and liability lines for which actual payments average 60 to 70 percent of premiums. The remainder of the premiums are for claims adjustment, underwriting and other administrative costs, and an average profit of 5 percent of premium values.

Premium levels vary enormously according to the liability frequency set deemed appropriate, as would be expected given the order of magnitude variation in the expected value of the various liability frequency sets. These premiums range from 12 to 17.5 percent of revenues for a typical site, depending upon level of coverage and liability frequency set assured. Two general principles should be noted from these premium levels, first, the cost per million dollars of coverage declines steadily with the costs of additional coverage as in most lines of insurance. Secondly, the bulk of the premium costs associated with covering the maximum possible accident in a liability frequency set are associated with the rare but high value claims (10 million dollars and up). This is true for all liability probability sets. The cost of coverage for rare accidents would account for over 25 percent of all premium costs even if the frequency of such rare accidents were assumed to be an order of magnitude smaller than the frequencies used in developing these estimates. In this respect, these liability frequency sets do not closely resemble most liability lines, but are similar to premiums for nuclear liability insurance.

Table 8

Premiums Associated with Various Levels of Coverage Under Hypothetical Liability Frequency Sets 1-4

Level of Coverage	Premium Per Site for Liability Frequency Set #1	Premium Per Site for Liability Frequency Set #2	Premium Per Site for Liability Frequency Set #3	Premium Per Site for Liability Frequency Set #4
$ 100,000	$ 470	$ 1,900	$ 1,600	$ 1,800
500,000	1,170	3,800	4,600	5,700
1,000,000	1,430	4,700	5,700	7,800
10,000,000	2,700	8,600	25,000	42,500
100,000,000	NA	21,000	89,000	175,000
200,000,000	NA	NA	104,000	NA

Derived from Table assuming 70% of premiums are used to pay for actual liability losses.

This property is based upon the assumption that similarly stringent safety and operating standards will be sufficient to prevent frequent accidents involving low levels of liability. Thus the decision of whether coverage should be required for rare but large accidents is critical to the question of estimated premium levels.

The choice of coverage level therefore, implies a tradeoff between insurance premium costs for hazardous waste managers and exposure of others to costs of a hazardous waste accident. Tables 9 and 10 are designed to clarify this tradeoff. Table 9 shows the expected value of costs not covered by insurance for various levels of coverage under various probability frequency sets. This may be considered a measure of the costs of liability imposed upon the hazardous waste facility but not fully reflected in cost structure of the firm. (For further discussion of this point, see the following section.) Table 10 shows the probability that an event not fully covered will occur at any given site in a single year. For all liability frequency sets, coverage of 1 million dollars covers all but very rare events, events with probabilities 1 in 1,000 or less. On the other hand, the expected value of costs not covered by insurance remains extremely high unless the 10 and 100 million dollar accidents coverage are required.

As noted above, however, it is not clear that liability insurance will be available at any price, especially for non-sudden non-accidental occurrences. The basic reason for this is the same reason that forced this study to use four liability frequency sets varying in expected values by an order of magnitude; there are not adequate data available now to estimate accurately the nature of the risk involved. Nevertheless, insurance is provided in very large quantities for a variety of difficult-to-estimate risks by American insurance companies. The first requirement is that the total premiums must be large enough to justify the investment in a specialized engineering and underwriting staff that could develop engineering (as against statistical) estimates

Table 9

Expected Values of Liability Claims not Covered for Various Levels of Coverage by Hypothetical Liability Frequency Set

Level of Coverage	Expected Value of Costs not Covered			
	for Liability Frequency Set #1	for Liability Frequency Set #2	for Liability Frequency Set #3	for Liability Frequency Set #4
$ 100,000	$1,571	$13,670	$71,000	$121,000
500,000	1,081	12,350	69,000	119,000
1,000,000	900	11,700	68,000	117,000
10,000,000	0	9,000	55,000	93,000
100,000,000	0	0	10,000	0
200,000,000	0	0	0	0

Derivation: Expected value of costs not covered equal to expected value of liability coverage minus .7 times premium values.

Table 10

Probability that an Event not Fully Covered by Insurance will Occur in One Year at One Site by Hypothetical Liability Frequency Set

Level of Coverage	Liability Frequency Set #1	Liability Frequency Set #2	Liability Frequency Set #3	Liability Frequency Set #4
$ 100,000	.0013	.0035	.001	.013
500,000	.0003	.0013	.0015	.003
1,000,000	.0001	.0003	.0015	.003
10,000,000	-	.0001	.00049	.001
100,000,000	-	-	.0001	-
200,000,000	-	-	-	-

Derivation: Probability of an event not fully covered occuring in one year at one site equal sum of frequencies with associated liability greater than the level of coverage.

of the probability of various liability claims. Table 11 shows the range in premiums per year associated with various levels of coverage and numbers of sites. For comparison, total liability (and associated lines) premiums in 1974 were approximately 1.9 billion dollars. Thus for 100 million dollar coverage levels, at 150 sites total hazardous waste premiums could amount to over 1% of all liability premiums. For a higher number of sites a similarly high share of all premiums is associated with only 10 million dollars worth of coverage. Nuclear insurance pools in 1976 maintained a specialized staff and insurance treaty arrangements with current premiums of under 16 million dollars. This arrangement began with far lower levels of premiums. However, insurance companies may have become involved anticipating significant growth of the industry. The size of potential premiums from hazardous waste managers thus may be large enough to offer an attractive insurance market. Because of the size of the potential claims, this market would almost certainly have to be served by either a formal or informal insurance pool. Further, the tendency to act conservatively in a poorly understood risk situation would mean that at least initially the premiums would probably be at least as high as those associated with liability frequency sets 3 or 4. A related approach would be the formation of an institution such as the nuclear insurance pool. In addition to providing a formal treaty and a specialized engineering and underwriting staff, these pools also have a large reserve fund. The importance attached to this reserve fund is not clear. One function could be to cover all or a significant portion of the costs of a possible nuclear accident. If the reserve is intended for such a purpose, and is part of the reason the nuclear insurance pool has been so successful, then for an industry that is small relative to the remoteness of the risk of a large accident, the premiums would need to include a significant safety loading over and above the premiums which might be expected for conventional insurance. Such a safety loading seems to be present in the case of current nuclear insurance rates. The size of liability rates cannot be explained by the existing liability record nor by an respected estimates of the liklihood of a large nuclear accident. The nuclear insurance pool partially compensates the nuclear industry for this large

Table 11

Total Premiums Per Year In Millions of Dollars for Various Numbers of Hazardous Waste Management Sites and Levels of Coverage

Number of Sites	Level of Coverage Per Site :	$1,000,000	$10,000,000	$100,000,000
150		.2-1.2	.4- 6.4	3.2- 26.3
500		.7-4.0	1.4-21.3	10.5- 87.5
1,000		1.4-7.8	2.7-42.5	21.0-175

Derivation: Premium levels shown in Table I-3 times number of sites.

safety loading by returning 70% of premiums after a 10 year period. At an interest rate of 10% however, return of 70% of a payment 10 years in the future would have a present value of only about 25% of the initial payment. Thus, at least in the early years of such a pool, the offset to premium costs offered by such a return is rather small.

Before leaving the subject of insurance, it may be noted that the private insurance industry is not the sole possible source of insurance. States and the Federal government have offered insurance or reinsurance in such diverse areas as flood damage, ghetto fire and property, hurricanes, and workman's compensation. However, the problem is that the hazardous waste industry even on a national basis is relatively small compared to the size of potential losses, so that a state or federal program would require either a large safety loading or a committment of the governments' own funds if a large accident occurred. Very few states could afford to commit themselves to a possible 100 million dollar expenditure, and those that could would probably be reluctant to do so. On the other hand, a state-run insurance program for smaller levels of coverage might be appealing to some states in the absence of any insurance industry response to this insurance need.

It is likely that an insurance plan will have to be carried out at the national level to be feasible: the risk must be spread as widely as possible. The risk can also be spread over several perils, as well as geographically. For instance, it may be possible to have the existing nuclear insurance pools extend coverage to the non-nuclear hazardous waste management industry.

Self Insurance and Going Bare

"Self insurance" is defined as accepting a risk for which the firm has sufficient assets to cover the liability in question. "Going bare" is accepting a risk that could not be met if it occurred and would cause the failure of the firm. (Dunn and Bradstreet estimated that in 1969 disasters caused 1.7% of all manufacturing business failures.) Distinguishing between self insurance, which might represent a viable method of assuring responsibility and going bare is a somewhat difficult problem.

State workman's compensation programs which allow self insurance usually do so on the basis of the judgement of a state board as to the financial viability of the firm and usually do not require assets sufficient to cover remote possibilities of disaster. If a rule were to be set up there are approaches that might be considered, with varying degrees of certainty that the necessary assets would be available. A relatively certain system would be a requirement that the liquidation value of the firm exceeded its total debt by an amount sufficient to assure whatever level of coverage was deemed appropriate. This would be an extremely stringent criteria, and for smaller firms might well require the special services of an accountant to estimate liquidation values. A somewhat less stringent test would simply require a tangible net worth of greater than the amount of coverage desired. Because tangible net worth is based on the book value of assets it can readily overestimate (as well as underestimate) the true net worth of the firm. For these reasons, greater assurance of adequate assets could be provided through requiring tangible net worth that was some multiple of the desired degree of coverage. This approach would have the advantage that the resulting value would be easily obtained as part of the annual reports of the firms in question. A third approach would be a requirement on net working capital (the difference between current assets and liabilities). A firm with net working capital equal to or greater than the total coverage requirement could be expected to have be able to meet any liability requirements. Combinations of these rules are also possible.

Self insurance may be less adequate than commercial insurance in that commercial insurance can be written on a per occurrence basis, covering more than one occurrence per year. The question arises, therefore, as to whether a self insurer should be prepared to cover more than one accident per year. For a single site, the probability of a second accident is extremely remote. Even for a firm with up to 20 sites the probability of a second accident within a year is still at least an order of magnitude smaller than the probability of a single accident. On the other hand, as the number of sites approaches 100, the probability of a second accident starts to equal the probability of a single accident at a single site. As a result, if some hazardous waste management firms have large numbers of sites, self insurance might reasonably require sufficient assets to cover two accidents.

Using a simple rule of tangible net worth in excess of required coverage levels, no more than 2 or 3 of the firms now engaged in hazardous waste management could meet a 100 million dollar liability requirement. The overwhelming majority of firms in the industry could not meet even a 10 million dollar liability requirement. The average firm in the industry engaged primarily in hazardous waste management could not even assure the ability to meet 1 million dollars in liability from its own assets. On the other hand, the number of firms that could meet a total liability requirement by combining present insurance and their net worth is significantly greater than the above at all levels of coverages. If the required limit coverage were limited to sudden and accidental events, many firms could handle a 1 million dollar liability claim and several could even handle a 100 million dollar liability claim.

The situation for generator disposers is highly variable and depends upon the industry in question. However, for at least some industries self insurance is at least a possibility for a significant number of producers. Thus, for example, all of the top 50 chemical producers have tangible net worth sufficient to cover 2 one hundred million dollar accidents.

Self insurance or self retention *to some degree* is feasible for almost all firms. Reliance only on self insurance is not prudent for any firm however. The general health of the industry requires some form of risk sharing.

The costs of self insurance begin with costs of the expected value of loss not covered by insurance (see Table 11) In addition to these costs are the costs associated with the following factors;

1) Insurance premiums are tax deductible whereas the liability loss is tax deductible only if it actually occurs.

2) Exposure to a major loss could force the firm to engage in very high cost, short-term borrowing and might dangerously reduce working capital and increase debt-equity ratios.

3) Most firms and most individuals are risk avoiders and prefer a small certain stream of income to a higher average but more uncertain income.

4) Cost of loans is larger in the absence of adequate insurance, and credit will generally be tighter.

As a result, where insurance is available, most firms will use commercial insurance in some form in preference to self insurance. In most cases the perceived costs of self insurance are greater than the insurance premiums for an equivalent risk. There are two types of exception to this. First, a firm may be large enough that a given type of risk can be treated as an expected cost; thus, many large firms may have high deductibles for certain types of insurance since they can effectively self insure for smaller accidents. Many larger firms self insure for workman's compensation or carry only excess or umbrella coverage for disasters, since for a large firm workman's compensation expense can, in fact, become a fairly predictable regular expenditure. The second exception is where due to uncertainty of the risks involved, the premiums are highly conservative or include such a large safety loading that the firm believes that even with special costs of self insurance it is cheaper to self insure than to accept the high risk estimates of the insurance industry. No data base exists to tell us how hazardous waste managers subjectively estimate the risks of their operations, however, the high levels of liability coverage and high associated expenses found in our conversations with selected firms indicate that many firms or their creditors perceive a significant degree of liability risk associated with their business.

As noted above, "going bare" is simply the act of exposing the firm to a potential liability payment that the firm will be unable to cover with its assets. Going bare is generally incompatible with EPA's goal of requiring financial responsibility. However, at the very highest potential liability levels market and policy conditions may make risk sharing impossible. In the absence of a limitation on liability by Congress and the Courts, hazardous waste management firms will inevitably "go bare" at those highest levels. With respect to the highest levels of liability coverage, virtually all firms now engaged in contract hazardous waste disposal are effectively going bare, and, in the absence of regulation, this is a reasonable practice for them. For a firm with an acceptable rate of return on investment, the actual value of the firm to its owners can be expected to exceed the book value of net worth by a factor of 2 to 4; and even for a non-risk-averter it would be advantageous to insure the firm against liabilities to at least this level. This point should be made very clearly in considering the incentives of a hazardous waste management firm; a firm with the average rate of return typical of the industry has at risk an asset with a value of almost three times the book value of tangible equity. Thus, the average hazardous waste management firm has at risk an asset with a value to its owner of over one million dollars. If financial responsibility is defined not as ability to meet the worst case liability, but only as having a significant value of assets at risk, then many of the firm currently in the industry could well be considered to meet such a criteria. On the other hand, a smaller firm that goes bare for higher liability values will still fail to cover a significant portion of the expected value of accidents under any of the above scenarios.

Table 12 shows the expected value of the various types of costs both for the hazardous waste firm and for those parties injured, assuming that the firm has normal profitability. The costs to the firm include both insurance premiums and remaining exposure up to the total value of the firm. The costs to the public are the costs of any claims that could not be met by either the insurance or the firm. Except under probability frequency set 1, a firm bears costs of less than a third of those born by the public. For a larger firm, with 10 million dollars of liability insurance and 10 million dollars in book value of net worth, the risks born by the company are approximately equal to those born by the public under all four probability frequency sets.

Table 12

Annual Expected Value of Costs (dollars) Born by
Hazardous Waste Management Firm and by General Public
Under Various Insurance and Self Insurance Assumptions

Insurance and Self Insurance Limits	Liability Frequency Set #1			
	Cost to the Firm			
	Premiums [a]	Risk to Own Assets [b]	Total to Firm	Cost to the Public [c]
300,000 Net Worth 1,000,000 in Liability Coverage	1,430	100	1,530	900
10,000,000 Net Worth 10,000,000 in Liability Coverage	2,700	0	2,700	0
	Liability Frequency Set #2			
300,000 Net Worth 1,000,000 in Liability Coverage	4,700	300	5,000	11,600
10,000,000 Net Worth 10,000,000 in Liability Coverage	8,600	3,000	11,600	8,000
	Liability Frequency Set #3			
300,000 Net Worth 1,000,000 in Liability Coverage	5,700	1,500	7,200	67,500
10,000,000 Net Worth 10,000,000 in Liability Coverage	25,000	15,000	40,000	50,000
	Liability Frequency Set #4			
300,000 Net Worth 1,000,000 in Liability Coverage	7,800	3,000	16,000	116,000
10,000,000 Net Worth 10,000,000 in Liability Coverage	42,500	30,000	63,000	72,500

a. From Table 8 .

b. Equal to probability of uncovered events times the difference between insurance coverage and liability up to 3 times net worth.

c. Equal to difference between total insurance covered plus value of firm and the expected losses.

Trust Funds

Trust funds may be relevant to two different situations, a trust fund to cover a single party, and joint trust fund to cover liability expenses. A trust fund would provide a relatively assured method, more certain than the assets of the firm itself. The costs of such a trust fund would tend to be rather high however, being simply represented as the difference between the return on the trust fund (which would accrue to the party setting up the trust fund) and the opportunity cost of capital. Such a system would normally cost the firm between 1 to 3% of the total cost of the trust fund, even assuming that he could in some manner obtain the necessary capital. A joint trust fund would work rather like an insurance pool, except that there would be no insurance company back-up if the fund were exceeded. We would thus expect the cost to approximate those of an insurance premium plus a safety loading necessary to build up the size of a fund to a level where it could cover an accident. This safety loading could initially readily double the costs over simple premium costs, depending on the number of members of a trust fund.

Chapter II
CONTINUITY OF OPERATIONS

A. Statement of the Problem

Hazardous waste management activities carry with them a series of functional requirements that extend from the time the site is inaugurated through the termination of the hazard associated with the final disposal of the wastes. As shown in Figure 2, the stages include:

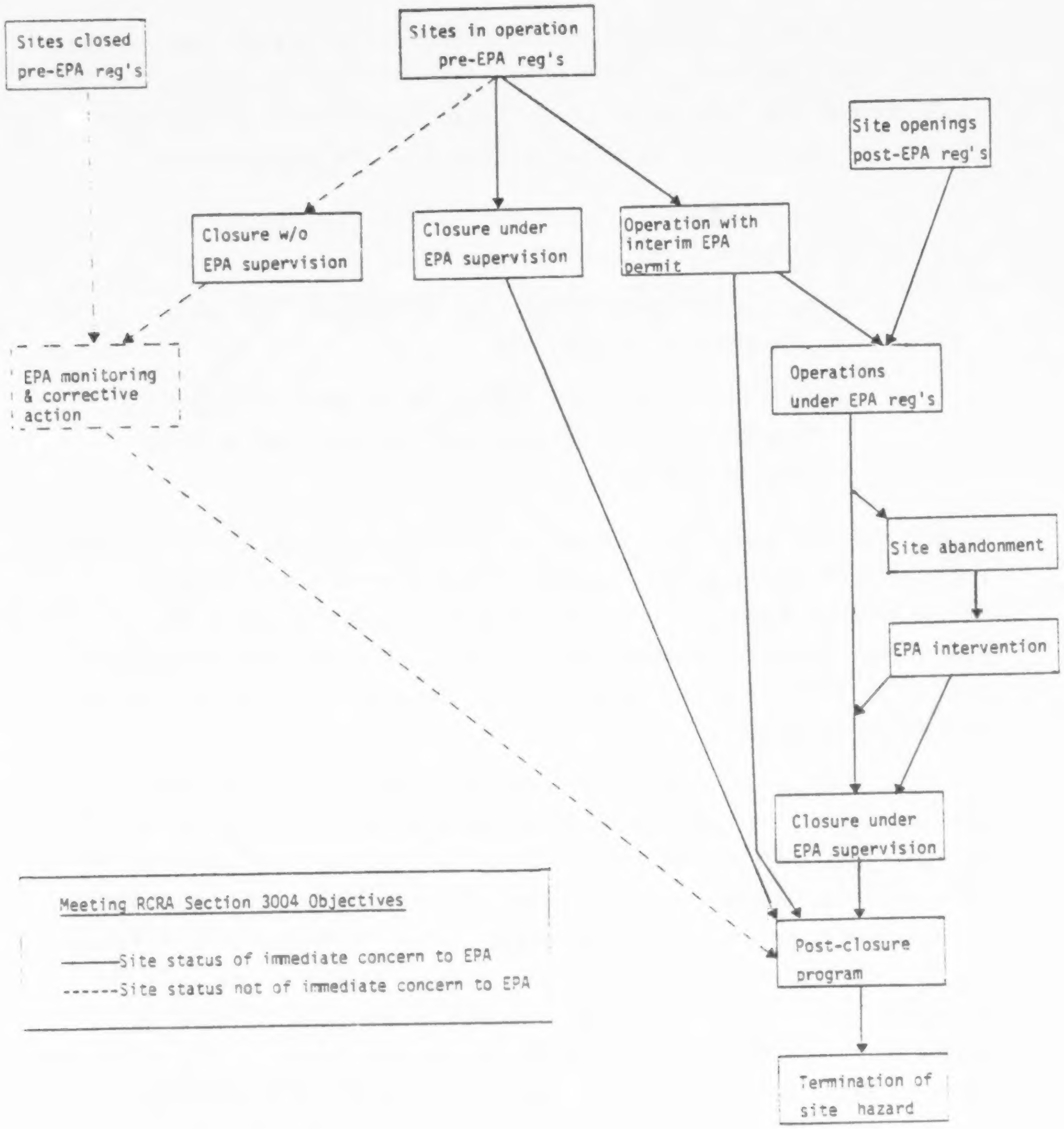
- Operations (during which hazardous wastes are collected, treated, stored, and disposed)
- Site Closure (when a site that is filled or has become uneconomic is closed) and
- Post-Closure Operations (during which monitoring, maintenance, effluent capture and treatment, and security programs are in effect.)

In addition, an operating site may be suddenly abandoned by its licensed operator. It must then be closed or turned over to a new operator. During each of these stages provision must be made for continuity of operations, financial responsibility, and contingency response capabilities. The difficulty with which each of these goals can be met varies from stage to stage.

Continuity of operation problems arise when the facility operator is 1) no longer available or has gone out of existence, or 2) is incapable of or unwilling to carry out the functions required for the safe and proper operation of the site, and so abandons the site during its operations or post-operations phases. The likelihood of this happening is increased when the site is no longer an economic asset, i.e. if the costs of treatment and disposal exceed income from the service, or when the site is filled and can accept no further wastes. Thus, the physical needs of the site, which include post-closure care, will inevitably

Figure 2

HAZARDOUS WASTES SITE HISTORIES


Sites closed pre-EPA reg's
Sites in operation pre-EPA reg's
Site openings post-EPA reg's
Closure w/o EPA supervision
Closure under EPA supervision
Operation with interim EPA permit
EPA monitoring & corrective action
Operations under EPA reg's
Site abandonment
EPA intervention
Closure under EPA supervision
Post-closure program
Termination of site hazard
Meeting RCRA Section 3004 Objectives
——Site status of immediate concern to EPA
------Site status not of immediate concern to EPA

outlast the immediate economic interest of the operator in its operation.

The problem of meeting post-closure responsibilities is aggravated by the difficulties inherent in predicting when the hazard is terminated. In addition to the undertainties surrounding their potential exposure to post-closure liability and clean-up costs, hazardous waste management companies may find themselves incapable of judging when their obligations for post-closure operations will end, and faced in some instances with obligations in perpetuity.

Longevity of the hazard posed by materials disposed of in hazardous waste sites will be affected by many considerations. The nature of the material is critical. Hazards were assumed to last 50 years for most organic residues (range 0-100 years); 200 years for certain persistent organics (range 100-500 years), and 5000 years for metal elements (range 500-10,000 years).

The methods used to treat hazardous material prior to disposal are another key variable affecting longevity. Some materials can be neutralized with other wastes. In other cases neutralization is overly expensive, or physically impossible. Disposal methods are another variable affecting longevity, as are the strategies used by the disposer in segregating wastes. Long longevity materials, for instance, could be isolated on a fraction of the land used for disposal. Thus the hazard longevity mix of the sites will reflect the decisions of EPA on defining hazardous wastes, on treatment, and on disposal standards. The study assumes that hazardous waste sites would continue to be considered hazardous until an explicit judgement had been made that the hazard had diminished to non-threatening levels, and that the process to be followed in reaching this judgement forms part of the continuity of operations management structure. It assumes, also, that this process will allow for discrimination between future alternative uses of the land on which the closed sites are located. For example, the land may be suitable for parks, golf courses or farming, but not for well-drilling, or residential construction. Hazard longevities will be reflected in the different uses. A disposer may therefore be able to use a portion of the site for new purposes immediately after completing the closure program, and a second portion some time later for a limited number of alternative uses. A remaining portion of the site may, for all intents and purposes, never be available for alternative use, and the site itself require perpetual care.

The extreme post-closure longevity of some of the hazardous wastes raises important questions about legal responsibility for the site. Normally, the owner of land and facilities is legally responsible for maintaining them in such a way that they pose no off-site threat. When they are sold, the new owner becomes responsible. The prior owner is only responsible if he or she failed to advise the new owner of an existing danger and the new owner could not reasonably be expected to discover it. In the case of a closed hazardous waste disposal site, the prospective new owner may be advised of the site's history but be, like everybody else, incapable of estimating the actual longevity of hazard, or its potential for producing catastrophic damage, or whether a release into the soil that will eventually cause damage has already taken place and will be traced back to the site. Because of these unknowns, the transfer of ex-hazardous waste disposal land, and responsibility, to new ownership poses a further challenge to continuity of operations and ownership requirements. Thus to the problem that the functional requirements of a closed site will continue to exist well after the principal economic interest of the operator has ended, are added the problems that legal responsibility may endure long beyond the corporate existence of the responsible entity, and that transfer on the open market of the most hazardous sites may not be possible at all.

Continuity of operation requirements may have at least five basic purposes, covering 1) post-abandonment, pre-closure maintenance of operations, 2) site closure, 3) post-closure site activities, 4) termination or limitation of operator responsibilities, and 5) land-use limitations. Organization of the activities required for continuity and provisions of the costs to cover them are included in the goals of continuity of operation requirements. In summary form, the purposes may be described as follows:

1) Post-abandonment, pre-closure operations
    a. Provide continuation of operation by new operator, or
    b. Provide closure of abandoned site
2) Site closure
    a. Ensure availability of site closure funds
3) Post-closure operations
    a. Ensure availability of funds for annual post-closure costs where operator continues to exist:
        (monitoring, maintenance, security, operations, maintenance of contingency plan)
    b. As in (a), but where operator has gone out of business or is otherwise unavailable (includes access to site)
    c. Ensure availability of funds for extraordinary, unpredictable post-closure costs, where operator continues to exist
        i. implementation of contingency plan (including clean-up)
        ii. liability costs
    d. As in (c), but where operator has gone out of business
4) Termination of operator responsibilities for closed sites
    a. Transfer or terminate operator responsibilities
5) Land-use limitations
    a. Maintain prohibition on inappropriate land-uses

State, state subdivision, municipal and public authority permit-holders will have different institutional characteristics from private sector permit-holders. These differences suggest that different financial responsibility and continuity of operation standards should be applied to the public facilities. With regard to standards for continuity of operations, the key characteristic of the public facilities is the permanence and reliability of the institutions to which they are attached. Rightly or wrongly, the longevity of the government is not at general issue, and indeed is likely to exceed that of an industry association. Too, these entities have funding mechanisms that make it unlikely that the costs of operating public hazardous waste management facilities cannot be met. EPA may therefore wish to exempt these entities from the standards required of private entities to assure continuity of operations.

A special problem is posed by current hazardous waste management owners and operators that fail to get permits and are prepared to leave the business instead. It appears that it is impossible to require of them the full set of requirements that permit-holders will have to meet. They are unlikely to have funds available; unlikely to be admitted to a mutual assessment association; and unlikely to qualify for pool insurance. Also, it may be contrary to legal principle to impose requirements on them retroactively if they choose to leave the business rather than comply with the new regulations. The most basic functions which EPA is interested in seeing performed are that of closure and post-closure monitoring. At least, EPA will then have warning of a situation that is developing and requires attention. Without monitoring nothing can be done. Closure and post-closure monitoring alone could be required of those about-to-be-closed operators. Costs would be relatively low, and could clearly be justified as a measure that any manager of hazardous materials could reasonably be expected to carry out anyway, regardless of the new regulations. The new regulations, in this view, only affirm the need for a practice that should be routinely implemented anyhow.

As with any continuity of operation requirement that may be imposed on these non-permit operators, the problem revolves around the question of the costs that may be imposed on him. We believe that it would be difficult to force many of the operators who will fall into this category to put up significant cash funds without causing considerable hardship and, possibly, bankruptcy. Thus, while proper closure and post-closure monitoring can be demanded, requiring a capitalized fund to do so, as proof of capability, seems to present insuperable difficulties.

B. Characteristics of an Ideal Solution

Unlike financial responsibility requirements, which seek to protect responsible entities from potentially catastrophic and unpredictable events, continuity of operation requirements seek to ensure that largely predictable, relatively constant, normal functions are carried out despite the actions of irresponsible entities, i.e. those that would default on any of the functional responsibilities connected with hazardous waste management, including responsibilities that exist after a site is filled and ceases to produce revenue, and over a period of time that may exceed the life of the entity.

Continuity of operations requirements differ from those of financial responsibility in basic ways, therefore. The challenge of continuity is basically to create an enduring institutional and operational capability; that of financial responsibility is to create a way of sharing risk. Continuity deals mostly with relatively small sums that can be accurately calculated on an entity-by-entity basis; financial responsibility deals with sums that are potentially very large, for which only a few members of the industry will ever be directly liable, and then only occasionally Continuity of operation requirements are only needed because institutions may fail; financial responsibility, because operations may be inadequate and accidents will occur.

The characteristics of an ideal solution to continuity of operation problems are oriented toward the institutional interests and capabilities of the hazardous waste industry. The characteristics may be described as follows:

1) Strengthening the ability of hazardous waste management companies to meet functional responsibilities, including operations, site closures, post-closure monitoring, maintenance and operations;

2) Providing compelling incentives to the companies to carry out these functions;

3) Creating an enduring back-up institution to step in if companies fail to carry out these functions. The back-up institution must have the capability to organize remedial efforts, legal capacity to do so, and the funds with which to pay for the efforts; and

4) Providing for an orderly, safe return of closed site land to other uses.

Two principles should guide the continuity of operations structure. First, the funds required to carry out functions on sites that are abandoned or otherwise inadequately maintained must be assured *before* the abandonment happens, and during the time the site is generating income, i.e. while it is still accepting wastes. Alternatively, funds could be gathered from existing site operators for ex post facto application to an abandoned site. Second, funds gathered in anticipation of a potential default by operators should be refunded to the operators who fulfill their obligations. If refund is not made, operators will lose incentive to discharge those obligations, and the institution designated to handle occasional and emergency site abandonments will instead find itself routinely handling an unnecessarily large number of stie closures and post-closure operations.

With the exception of those things done to respond to the problem of the excessive longevity of hazard and responsibility, the intent of continuity of operation requirements is not to relieve hazardous waste operators of their obligations, but to ensure operational needs in the event of their default.

C. Basic Continuity of Operation Costs

1. Closure and Post-Closure Expenditures

While it is not the purpose of this study to determine closure or post-closure operating requirements or their associated costs, some rough estimates of costs are necessary to provide perspective on the issues involved. Ideally, continuity of operation expenditures can be divided into three categories: 1) single lump sum expenditures (of which the most important is site closure) 2) predictable annual expenses (maintenance, monitoring, operations, security, etc.), and 3) unpredictable or extraordinary annual expenditures (contingency plan implementation, and liability).

Unfortunately, little data is now available to estimate these various categories of costs. They will depend in part upon the closure and post-closure requirements to be set by EPA, the precise nature of the site, and the types of hazardous waste involved. Given the difficulty of general estimates, most states have set up laws that leave the precist cost estimates to be determined on a site by site basis. The state of Oregon provided the study team with a breakdown of estimated costs for the one hazardous waste site in that state: these included $8000 for permanent closure of the site, five years of intensive monitoring at $2930 per year, and long-term monitoring and security also at $2930 per year.

The costs of premiums associated with post-closure liability insurance, if this liability is to be met through insurance, would depend upon the level of coverage chosen, and even then cannot be predicted with accuracy (see Chapter I). For low levels of associated risk and of coverage, premiums of $2000 to $10,000 per year might be in order. For the highest levels of risk, premiums in the $175,000 per year range can be readily justified, if insurance is available at all.

The cost of providing for continuity requirements annualized over a period equal to the active pre-closure life of the stie is dependent upon the actual life of the site and the points in time at which the firm must part with the money. A number of schemes to finance continuity of operations were considered. Their annualized costs vary considerably.

Five basic approaches may be summarized as follows:

1. The firm must place a sum of money equal to the estimated fund size into some form of account, but may collect any interest on this account other than that necessary to assure that the size of the account keeps pace with inflation, the "*full lump-sum*" approach.

2. The firm places in an account a sum of money calculated to provide an adequate fund if all interest is retained for growth of the account, the "*lump-sum plus interest*" approach.

3. The firm makes an annual payment into the account which is calculated to provide an adequate fund at the end of the operational life of the site, the "*annual payment* approach.

4. The firm sets up a fund for continuity costs at the end of the life of the site, the "*end-of-site*" approach.

5. An on-going firm earning profits pays for continuity expenditures as they occur, the "*payment upon occurrence*" approach.

The above mechanisms are listed in order of costs, with the most expensive system first and the least expensive last. The precist difference among these mechanisms is dependent upon the operationsl and post-closure life of the site, the real interest rate, the real opportunity costs of capital to the firm, and the definition of cost used. The remaining operational life of the site will vary both with the remaining capabity of the site and the rate of demand for its usage. As noted above, real interest rates vary over time, and are also dependent upon the types of securities on which the interest is accruing. Ordinary savings accounts, U.S. government bonds and high rated state and municipal bonds would provide the lowest real interest rates, high rated corporate bonds would perform somewhat better, and investments in selected high grade stocks the best. However, the degree of risk to the fund would also go up with the real interest rate. The real opportunity cost of capital to the firm will vary according to the profitability of the firm, the particular tax advantages open to it, and the debt equity ratio of the firm. Assuming government bond rates are used in calculating the real interest rate, the real opportunity cost of capital to the firm could be from 1.5 to 2.5 times the real interest rate. Finally, one must take care in the definition of costs employed. The definition use in this context throughout thos text is that costs are defined as the necessary increase in revenues per eyar to assure that the profits remain constant. (Under this definition, the costs of an annual expenditure are simply equal to the size of that expenditure.) A somewhat more complex definition would be loss to the firm if it is unable to pass on the costs. In this stiuation the costs to the firm would be approximately 1/2 those computed under the first definition, with the remainder of the costs being absorbed by the government through reduced corporate profit taxes.

For the *full-lump sum* approach described above, the annual constant dollar costs over the life of the site may be calculated as:

$$\left(\frac{r_2}{1 - (1 + r_2)^{-L}} - r_1\right) F$$

Where F is the required fund size in dollars
L is the life of the site
r_1 is the real interest rate earned by the fund
r_2 is the real opportunity cost of capital

For the *lump sum plus interest* approach, annual costs over the life of the site may be calculated as:

$$\left(\frac{r_2}{1 - (1 + r_2)^{-L}} (1 + r_1)^{-L}\right) F$$

with the abbreviations the same as above. The term $(1 + r)^{-L} F$ represents the required initial size of the fund.

For the *annual payment* approach, the annual costs over the life of the site may be calculated as:

$$\frac{r_1}{(1 + r_1)^L - 1} \quad F$$

This computation also gives the required size of the annual payment in current dollars.

For the *end-of-site* approach, the annual constant dollar costs over the life of the site are:

$$\frac{r_2}{(1 + r_2)^L - 1} \quad F$$

The *payment upon occurrence* approach calls for recalculation of the required fund size, using the opportunity costs of capital relevant to the firm; a formula would be:

$$\frac{r_2}{(1 + r_2)^L - 1} \left(C_1 + \frac{\left(1 - (1 + r_2)^n\right)}{r_2} C_2 \right)$$

Where C_1 is site closure cost
C_2 is annual predictable cost and the average yearly non-predictable cost

Combinations of these approaches, such as an initial payment of half the amount required followed by annual payment for the remainder over the life of the site, may be calculated by simply using the appropriate fractions of the fund size. A final possibility, a series of annual payments over a time period T less than the life of the site, can be annualized to actual site to cost per year of operation by the following formula:

$$\frac{r_2}{1 - (1 + r_2)^{-L}} \left(\sum_{0}^{T} \frac{\dfrac{r_1}{(1 + r_1)^{t} - 1}}{(1 + r_2)^{t}} \right) F$$

Table 13 shows the results of these formulas in annual costs per one hundred thousand dollars of required fund size for various site lives, and combinations of real interest rates and real costs of capital. In general, the greater the difference between the real interest rate on the account and the real opportunity costs of capital to the firm the greater the difference between the various approaches. The actual size of the costs however, is uniquely dependent on the actual real interest rates and real opportunity costs of capital employed. For most firms, the typical situation will fall between the costs of the second two combinations of interest rates and costs of capital shown in the Table. The end-of-site and payment upon occurrence approaches represent the minimum possible costs to the firms of meeting continuity requirements, with the end-of-site approach applicable to firms which do not continue to exist following closure, and the payment upon occurrence approach to firms which continue other activities after the closure of the specific site.

For a typical site currently in the hazardous waste management industry (see Introduction), these costs range from .031 to 1.3 percent of revenues per \$100,000 of required fund size, depending on the site life interest rates, and opportunity costs of capital. If a \$350,000 fund, as estimated above, is a typical requirement of continuity, then the various mechanisms entail annual costs of .11 percent to 4.55 percent of revenues. The dffierence in cost between the full lump-sum and the payment upon occurrence approaches (which respectively are maximum and minimum possible continuity expenditures) ranges from .5-1.1 percent of revenues per \$100,000 of required funds, for similar sites, interest rates and opportunity cost of a capital conditions.

Table 13

Annualized Costs Per $100,000 of Fund Size
for Alternative Funding Mechanisms

Life of Site	Approach	A	B	C
		Real Interest Rate = .01 Real Opportunity Cost of Capital = .02	Real Interest Rate = .02 Real Opportunity Cost of Capital = .035	Real Interest Rate = .02 Real Opportunity Cost of Capital = .08
10 yrs	Full Lump Sum	$10,000	$10,000	$12,900
	Lump Sum + Interest	10,000	9,900	12,200
	Annual Payment	9,600	9,100	9,100
	End of Site	9,100	8,500	6,900
	Payment Upon Occurrence[a]	5,000	5,200	2,200
20 yrs	Full Lump Sum	$5,100	$5,000	$8,200
	Lump Sum + Interest	5,000	4,700	5,500
	Annual Payment	4,500	4,100	4,100
	End of Site	4,100	3,500	2,200
	Payment Upon Occurrence[a]	2,300	2,100	700
30 yrs	Full Lump Sum	$3,500	$3,400	$6,900
	Lump Sum + Interest	3,300	3,000	3,800
	Annual Payment	2,900	2,500	2,500
	End of Site	2,500	1,900	900
	Payment Upon Occurrance[a]	1,400	1,200	300

Derivation: See Text for Formulas Employed

[a] Assumes 10% of the Fund is for shut down costs, the remainder for annual expenditures in perpetuity.

D. Meeting Continuity of Operation Objectives

A number of alternative methods for meeting continuity of operation objectives have been proposed, some complementary, some redundant. The discussion here distinguishes between mechanisms or schemes that may enable the objectives to be met, the source of funds to implement the schemes, and the agency responsible for organizing and implementing the scheme.

The alternative schemes for meeting different continuity of operation objectives are: owner asset requirements; trust funds; bonds; escrows; mutual assessments, RCRA 7003; site transfers; easements; covenants; and zoning.

Alternative sources of funds to implement the schemes are: hazardous waste generators; hazardous waste management operators; and the general public, through tax revenues.

Alternative agencies to organize and implement the schemes are: government agencies; the hazardous waste generators; the hazardous waste management industry; and third party trustees.

Diversity within the hazardous wastes industry makes it difficult to conceive of a single method to meet continuity of operation objectives that is both fully equitable and fully effective.

Included in the industry are some of the largest industrial firms in the world, as well as small companies grossing under $100,000. Many of the future EPA hazardous waste permit holders will only incidentally be in the hazardous waste business, a side activity required by their primary manufacturing activities. Others will be solely in the business of taking the hazardous wastes generated by others, treating and disposing them. While most will be private sector firms, some municipal, county and state facilities will be included in the industry. Some companies will have up-to-date technology and management; others will be less capable of meeting high technological and managerial standards. Finally, some permit holders will be handling the most hazardous, most long-lived wastes; others only relatively safe, short-lived wastes.

Taking all these considerations into account, to say nothing of specific waste treatment strategies, or geographic, hydrological and geological characteristics, presents an administrative task of unmanageable proportions. Inevitably, we must conclude that some inequity for some members of the industry will be considered one of the costs of membership in the industry, and that a less-than-perfect effectiveness will be accepted by society as one of the costs of our economic system. A combination of the methods described here can minimize but not resolve the dilemma.

E. Alternative Methods of Meeting Continuity of Operation Objectives

1. Guarantee Closure and Post-Closure Responsibilities

The first series of alternatives to be considered are those that seek to guarantee that closure and post-closure responsibilities will be met by site operators, or in the event of an operator's default, that funds will be otherwise available to meet the responsibilities. These alternative schemes include: minimum owner asset requirements, trust funds, bonds, escrows, and mutual assessment associations. Subsequent sets of alternatives will examine what can be done to: provide emergency access to an abandoned site; terminate operator responsibilities; and prohibit future misuse of a closed site.

a. Minimum Owner Assets Requirements

Under this approach the net assets or liquid net assets of a hazardous waste management firm would be used as a basic indication of the stability, capacity, and reliability of the firm. The presumption is that a firm with substantial assets is sufficiently unlikely to abandon a site that it need not be obligated to meet the requirements imposed on an operator with smaller assets; the assets are a surrogate measure of long-term commitment, such as ownership of other newer sites.

Pros and Cons

The advantage to this approach is self-evident. Companies with adequate asset levels would qualify under continuity of operations standards without requiring a reserve. The disadvantages are equally self-evident: 1) Only the reliable companies, presumably, would qualify, while the need is to cover those companies that are less reliable. 2) A company with a high level of assets might find those assets plummeting in a short period of time. For a regulatory agency to monitor the company, catch it as it fell below the minimum level, and immediately impose on it the requirements that the other weaker companies have had to meet -- and precisely at a time when the fortunes of the company are already under pressure -- seems of dubious reliability. 3) If the presumption that reliability is directly related to assets is incorrect and a company becomes insolvent, the regulatory agency, and society generally, are left with no recourse, no assets to apply to the needs of the site.

Costs

For those who qualify, the costs of this approach would be extremely low, amounting only to the cost of establishing the appropriate assets to site cost ratios, and assessing the evidence of assets produced by the applicants. Except for these administrative costs, the costs of this approach will be those associated with the end-of-life and payment upon occurrence approaches; the former if the firm ceases to exist with the closure of the site, and the latter if the firm continues as a profit-making entity.

Implementation

The basic obstacle to implementation of a Minimum Owner Assets requirement appears to be the uncertain nature of the relationship between assets and reliability. Though continuity of operation functions and costs are relatively predictable, the study did not uncover existing programs that have turned this type of approach into an operational reality. The State of Maryland, for instance, provides that permit applicants may be required to maintain a surety bond, assure self-insurance, transfer operation of ownership to the State, *or* "provide evidence of financial ability to properly operate and maintain a facility" (08.05.05 Control of the Disposal of Designated Hazardous Substances, .10.A.4, Maryland Registry, V. 4, no. 3, Feb. 2, 1977). The administering agency does not expect at this time to construct formulae for assessing financial responsibility. Instead, each applicant will be judged separately by a variety of general criteria, such as size and operating budget. Those companies that appear clearly capable of meeting continuity of operation responsibilities will be granted permits. Those of uncertain or marginal capability will be required to post a surety bond in an amount to be determined on a case-by-case basis, not to be less than $10,000. Whether the imprecision with which the evidence required is defined will permit an effective use of the regulation remains unclear at this time, as it is only now being put into effect.

Feasibility and Practicality

Of all the alternative methods of ensuring continuity of operations, that of requiring minimum owner assets is the easiest to implement, requiring little more than the regulation itself and an evaluative process within the administering agency. But because of its relatively imprecise nature, and because it would exclude applicants with fewer assets who might nonetheless prove reliable members of the hazardous waste management industry, the requirement is impractical if used as the sole method of meeting continuity objectives, and largely unnecessary if proposed for use in combination with any of the other methods discussed here.

b. Trust Fund Requirements

A second possible method of meeting continuity of operation objectives is to require the establishment of trust funds, the principal and revenues of which would go to ensure the performance of continuity of operation functions -- site closure and post-closure monitoring, maintenance, security, operations, etc. In addition, trust funds might be used to pay premiums for post-closure liability insurance, if this is to be required under the RCRA 3004 financial responsibility standard.

Of all the possible methods of meeting continuity of operation needs, only the trust fund approach contemplates the establishment of an independent entity charged with assuring continuity of performance. The necessary funds, administered by a trustee (a fiduciary who is legally responsible for the appropriate use of the fund), are isolated in the trust and used only for specified purposes. The entity lasts, then, as long as the funds and their purpose exists subject to legal limitations on indefinite operation which can be provided through appropriate structuring of the trust.

Typically, a trust fund is established to take care of future needs. A common arrangement is to use the investment earnings of the fund to meet the purpose for which it was established, leaving the principal intact. No refund need be contemplated under a trust fund arrangement, nor is the original source of the fund obligated, by the mere fact of having established it, to contribute further should the fund not be sufficient to meet its stated purpose.

Within the hazardous waste industry trust funds could be used to meet continuity of operation objectives in two basically different ways:

1) Individual trust funds could be set up for each site, or each operator. Disbursements from each fund would only be applied to the closure and post-closure needs of the site or operator for which it had been set up.

2) A central trust fund could be created on an industry-wide basis, built up from the contributions of every industry member. Disbursements would be used on an emergency basis to meet the closure and post-closure responsibilities that individual operators have failed to carry out.

The central trust fund approach is based on assumptions that only a few defaults will occur. Therefore, the size of the central fund would be much smaller than the sum of the individual, site-specific trust funds, which are based on the assumption that the functions at any site may be defaulted.

If the first approach were adopted, one trust fund per site or operator, the fund and its interest earnings would presumably be reimbursed as the operator met the sequence of closure and post-closure actions required by EPA. If the second option is adopted, where a central trust fund is established to meet the needs of only those sites that have been abandoned, presumably no reimbursement would be available, though the fees required to build and maintain the central fund might be adjusted to reflect the level of disbursements made.

Pros and Cons

Trust funds present a general advantage over other possible methods of meeting continuity of operations objectives: funds are built up during the time an operator's income from a site is greatest, and then secured for use when an operator's immediate interest in a site is at its lowest, when it has ceased producing revenue but still requires maintenance expenditures. It is the isolation of the funds that makes this scheme attractive. Regardless of the subsequent history of the operator, society is assured, to the extent it can be, that hazardous wastes receive the treatment they require over periods of time potentially so long that they exceed the degree of permanence that can reasonably be expected of all hazardous waste management firms. But for the same reason, trust funds present a significant problem: they require the setting aside of funds to which the operator no longer has access. These funds might otherwise be used by the operator in expansion, technological investment, or profit-taking.

The two different types of trust funds -- a central industry-wide fund or individual funds per site and operator -- have different advantages and disadvantages. A central industry-wide fund used only for emergency purposes where an operator has defaulted would require a smaller total capital amount than the total capital that would be set aside under an individual trust fund approach. The industry-wide approach takes advantage of the assumption that defaults would happen infrequently and requires all members to share in that risk. The advantage of the individual trust fund approach is that each operator would be reimbursed from the trust fund as the sequence of closure and post-closure obligations was met. Under the individual fund approach, the operator is left with a strong incentive to meet continuity of operation obligations. Under a central fund approach, where funds are only available for defaults, the individual operator has no direct financial incentive to carry out its obligations. The central fund, set up for emergency use, may instead find itself having to cover a greater number of sites than originally thought likely, as individual operators who find they have nothing else to lose abandon their filled sites. Individual trust funds would be particularly vulnerable to inflation and the source of the funds would presumably have discharged its financial responsibilities for closure and post-closure cash at the time the fund was created. A central trust fund, with annual assessments being made against industry members for its upkeep, would be able to withstand inflation better as the assessments would reflect costs charged to the fund.

Costs

The size of funds necessary to provide for closure and post-closure costs are dependent upon the actual size of the various expenditure items listed above, the length of time that these costs must be maintained, and the real rate of interest that the fund can earn. The real rate of interest is defined as the actual rate of interest minus the inflation rate. Historically it has averaged from 1% to 4%, with lower figures in periods of rapid inflation. The formula for computing the fund size is:

$$F = C_1 + \frac{1 - (1 + r_1)^{-n}}{r_1} C_2$$

Where F is the size of the fund in constant dollars

C_1 is site closure cost

C_2 is annual predictable cost and the average yearly non-predictable cost

n is the length of time the annual costs must be maintained

r_1 is the real interest rate

Table 14 shows how the size of the multiplier for the annual costs varies with length of time the annual costs are anticipated to be required and with the real interest rate. Because of the adjustment for inflation implied by the use of a real interest rate and the choice of low risk investments for the necessary funds, the size of the fund is significantly affected by the choice of the length of time the expenditure must continue. At a 2% real interest rate, the difference between a minimum assumed average life for hazardous waste of 50 years and of perpetuity still results in an increase in the size of the fund by 58%. If Oregon's assumptions about monitoring and shut down costs are accepted, the necessary fund to be able to meet them in perpetuity is approximately $150,000. Since this does not cover insurance premiums or provisions for contingency plan implementation, additional costs requiring a minimum additional fund of $200,000 could readily be included, for a total fund size of $350,000. This is considerably in excess of Oregon's actual cash bond requirement of $75,000, which does not apparently include provisions for post-closure contingencies or for post-closure liability, and uses a nominal rather than a real rate of interest.

The above calculations were developed in constant dollars. The actual size of the fund in current dollars will need to grow over time. Even at an inflation rate of 2%,(which has not been observed since 1965,) a sum that would originally have been adequate would fall over 33% short after 20 years. At a more realistic (but some would still argue too low) inflation rate of 5%, the originally adequate sum would be over 66% too small to adequately cover the calculated expenditures. How this problem should be dealt with depends upon the exact nature of the option chosen. Systems in which the continuity is assured through demonstration

Table 14

Multipliers for Annual Expenditures by Real Rate of Interest and by Length of Time Expenditures Must be Continued[a]

Real Rate of Interest	Length of Time Expenditures Must be Continued: (years)					
	10	20	30	50	100	In Perpetuity
.01	9.5	18	26	39	63	100
.02	9.0	16	22	31	43	50
.03	8.5	15	20	26	32	33

[a] Derivation: Multiplier equal to $\frac{1 - (1 + r)^{-n}}{r}$

Where r is the real interest rate and n is length of time expenditures must be continued. All figures rounded to two digits.

of the existence of adequate assets, such as owner asset minimums or surety bonds, could either have a constantly escalating minimum requirement, or could be set as a multiple of 2 to 4 times the estimated current dollar size of the funds needed for continuity. For situations involving either a full coverage payment, such as a cash bond, escrow account or trust fund, and for situations involving annual payments to an escrow account or trust fund, the problem of inflation can be resolved by conducting all calculations of required fund size or payments using a real interest rate.

The real interest rate is the net of the interest gained from investment and inflation rates. As post-closure funds are likely to be invested in interest bearing securities of the U.S. (or possibly some other secure investment) the real interest rate is likely to be relatively low. The rate of 0.015 (1.5%) is used in this report. EPA may wish to choose a different real interest rate. The effect of doing so is suggested in Tables 15 and 16. These show the different annual payments that a permit-holder would make to the post-closure cost trust fund under different real interest rate and site operational lifetime assumptions. Table 15 assumes a five year annual cash deposit schedule; Table 16 a ten year schedule.

The payment of the cash deposit which will provide funds for post-closure costs could be spread over the first five years of the permit. EPA may wish to sepcify a different period of payment. Later payment, i.e. payment stretched out over a longer period of time, will require a higher total deposit. Earlier payment will require a lower total deposit. The different effects of a five and of a ten year payment period, under various real interest rate and site operational lifetime assumptions, are also shown in Tables 15 and 16.

Both real and nominal interest rates on U.S. government securities have varied enormously historically; Table 17 shows the post-war real rates of return for U.S. government 10-year securities (both shorter and longer term securities tended to have slightly lower real rates of return during this period). During the post-war period, real rates of return on 10-year government bonds have varied from -2.89 percent to a high of 2.36

Table 15

Real Interest and Site Life: Five-Year Annual Deposit Payment Schedule to Provide a Fund Sufficient to Produce a Post-Closure Annual Income of $13,000 in Perpetuity

Real Interest (r_i)	Site Life (L) Years				
	10	15	20	25	30
.005	493,654.09	487,338.57	475,339.81	463,621.74	452,208.55
.010	240,081.84	228,428.11	217,344.83	206,795.89	196,758.03
.015	153,837.69	142,799.87	132,555.29	123,044.89	114,218.44
.020	110,910.25	100,454.83	90,985.04	82,407.95	74,639.42
.025	85,305.62	75,397.74	66,640.62	58,900.59	52,059.54

Table 16

Real Interest and Site Life: Ten-Year Annual Deposit Payment Schedule to Provide a Fund Sufficient to Produce a Post-Closure Annual Income of $13,000 in Perpetuity

Real Interest (r_i)	Site Life (L) Years				
	10	15	20	25	30
.005	252,940.19	246,709.75	240,631.57	234,703.64	228,921.60
.010	123,028.00	117,023.29	111,345.22	105,969.33	100,826.00
.015	79,779.59	74,056.23	68,743.46	63,811.82	59,233.99
.020	58,198.28	52,711.97	47,742.86	43,242.18	39,165.77
.025	45,282.49	40,023.12	35,374.61	31,266.00	27,634.59

Table 17

Real Interest Rate on Ten Year U.S. Government Securities

Year of Issue	Real Interest Rate[a]
1943	-2.89
1944	-2.45
1945	-2.34
1946	-2.79
1947	-1.74
1948	- .16
1949	- .04
1950	- .76
1951	- .59
1952	.28
1953	.68
1954	.41
1955	.62
1956	.77
1957	1.32
1958	1.01
1959	1.99
1960	2.36
1961	1.11
1962	1.10
1963	.55
1964	.43
1965	- .38
1966	- .77
1967	-1.14

a. Derivation: real interest rate equals nominal interest rate minus the inflation rate divided by 1 plus the inflation rate. This formula is an approximation which somewhat underestimates the real interest rate when the bulk of the inflation occurs in the final years and overestimates when the inflation occurs early in the life of the bond.

Source: Nominal Interest Rates from Moody's Investor Services, Inflation Rates from Economic Report of the President (1977), derivation of real interest rates by IR&T.

percent, and there have been as many issues characterized by a negative rate of return as a positive one. The key to the periods of negative return has been significant periods of unanticipated inflation; the first set of negative real rates were brought about by the unanticipated Korean war inflation and the second set by the inflation related to the unanticipated energy crisis. The arithmetic mean for the period examined is approximately zero. Table 17 shows real interest rates only through 1967 because after this date the bond would not yet have matured. However, if we examine inflation rates to date and assume a 5-6 percent rate of inflation for the future, real rates of return would show the same pattern as that within the period examined, i.e., some negative and some positive rates of return, with a near zero average rate of return. A zero or negative interest rate means that no possible fund size could be expected to provide fund perpetually.

Given this problem, it is useful to examine the question of how long a fund using a given real interest rate for computation purposes could last if actual real interest rates are below those used in calculating fund sizes. Table 18 shows how long a fund would last for a site with a life of twenty years under various assumed real interest rates and various actual interest rates. If a 1.5 percent interest rate is used in the fund calculation formula, even a zero actual interest rate would still result in adequate operating funds for over 50 years. Thus, while not providing for true perpetual maintenance at historical interest rates, the resulting funds do provide for post-closure operation and monitoring for a significant period.

The two basic trust fund approaches, individual or central, have different cost structures. The costs of the individual approach include the opportunity cost to the operator of setting aside funds initially, from which are subtracted the actual costs of closure, and the interest accrued by the fund between the time of collection and disbursement. The costs of the central approach include the funds contributed by each operator, to which are added their own actual costs of closure.

TABLE 18

Length of Time (Years)
A Cash Fund Computed According to an Assumed Real Interest Rate Will Last at Various Actual Real Interest Rates

Actual Real Interest Rate (percent)	Assumed Real Interest Rate Used in Calculating Fund Size (Percent)		
	1.0	1.5	2.0
		years	
-2.0	40	28	21
-1.0	54	36	26
- .5	66	42	30
0	84	51	35
.5	121	64	42
1.0	-	90	52
1.5	-	-	72
2.0	-	-	-

Derivation: for actual real interest rate = 0, formula is

$$\frac{5 \cdot AP}{AC}$$

where AP is annual payment to the fund and AC is annual cost of post closure monitoring and operation.

For actual real interest rate other than 0, number of years equals

$$- \frac{\ln \left[1 - i \left(\frac{5 \cdot AP \ (1 + i)^{L-5}}{AC}\right)\right]}{\ln \ (1 + i)}$$

where i is the actual real interest rate and L is the life of the site.

For the above computations a site life of 20 years was assumed.

The two basic trust fund approaches, individual or central, have different cost structures. The costs of the individual approach include the opportunity cost to the operator of setting aside funds initially, from which are subtracted the actual costs of closure, and the interest accrued by the fund between the time of collection and disbursement. The costs of the central approach include the funds contributed by each operator, to which are added their own actual costs of closure.

For an individual trust fund the costs are those of the full lump-sum, lump-sum plus interest, and annual payment approaches described above, depending upon the exact rules for the trust fund. The cost of a centralized trust fund will depend upon the failure rate of the members of the trust fund. Present data does not permit an estimate of this figure for the hazardous waste disposal industry. Failure rates for business enterprises as a whole average .1-.6% per year. Exits from business not involving formal business failure average 7-10% per year. The rate of hazardous waste firms failing to provide adequately for continuity could probably be expected to fall between these two figures. While capitalization is higher than for many types of businesses, this is a relatively new business and could be expected to have many young and inexperienced firms, which tend to be more failure prone. If a centralized trust fund is set up requiring that adequate funds be placed in it initially to cover all future failures with the interest in the trust fund, then the total annualized cost of such a trust fund per site would be given by

$$\frac{f}{r_1} \quad \frac{r_2}{1 - (1 + r_2)^{-L}} \cdot F$$

plus the costs of the end-of-site and payment upon occurrence approaches as appropriate. Rather than calculate these costs for various failure rates, Table 19 shows the percentage failure rate at which a centralized trust fund plus paying continuity costs under the end-of-site and payment upon occurrence approaches is preferable to the full lump sum approach. Unfortunately, these break even failure rates are small enough so that it is difficult to determine which scheme would typically be preferable.

Implementation

A small number of States provide for trust funds, or their functional equivalents, in their hazardous waste management closure and post-closure regulations. Oregon, for example, requires that a $75,000 cash bond be built up within ten years after a license is issued. Non-refundable, the bond is in fact a trust fund, out of which the State pays closure and post-closure costs automatically. As the site has been deeded to the State under the Oregon scheme, there is no obligation upon the operator to carry out these functions. The State of Washington has a similar scheme under consideration, though Washington expects to purchase the hazardous waste site directly and contract for the disposal service. The contract operator will pay fees to the fund, calculated to offset pre- as well as post-closure costs. Oregon expects to have no more than one hazardous waste site; Washington to have one extremely hazardous site and a number of dangerous material sites. Their funds therefore resemble the individual fund approach discussed above. Kansas, with more than one site or operator, requires the equivalent of an individual operator trust fund, in addition to a mixed surety and cash bond requirement. Called a non-refundable "escrow account", it is set up to provide the Kansas Department of Health and Environment funds for post-closure monitoring in perpetuity. In Wisconsin, the proposed hazardous waste management regulations require operator ownership and responsibility for a site at least ten years after its closure. A Waste Management Fund is established for the State. One of the purposes of the Fund is "acquire and maintain abandoned sites". The Fund will be built up by fees collected quarterly from all operators. Operators carrying out closure and post-closure operations are not reimbursed. The Wisconsin draft regulations resemble the central trust fund approach.

Table 19

Failure Rate Per Site Year Below Which an Industry Wide Trust Fund Plus Internal Fund is Preferable to an Individual Trust Fund Approach

		A	B	C
Life of Site		Real Interest Rate = .01 Real Opportunity Cost of Capital = .02	Real Interest Rate = .02 Real Opportunity Cost of Capital = .035	Real Interest Rate = .02 Real Opportunity Cost of Capital = .08
10 yrs	Firm closes with closure of site (End of Site Approach)	.09%	.3%	.93%
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	.5%	.96%	1.7%
20 yrs	Firm closes with closure of site (End of Site Approach)	.2%	.6%	1.5%
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	.55%	1.2%	1.8%
30 yrs	Firm closes with closure of site (End of Site Approach)	.29%	.88%	1.7%
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	.6%	1.3%	1.8%

Derivation: Break even failure probability computed as $f = d \frac{r_1}{r_2} \frac{1}{1 - (1 + r_2)^{-L}}$ where d is differential in percentage terms between the full lump sum approach and the end-of-site approach for firms closing with closure of site and the payment upon occurrence approach for firms on-going after closure of site.

[a] Assumes 10% of the fund is for shut down costs, the remainder for annual expenditures in perpetuity.

Outside the hazardous waste industry, the use of trust funds is a well established mechanism for assuring the isolation of large sums for a variety of purposes. Some of the more important funds, described in the Appendix to this report, include the Deposit Insurance Fund of the Federal Deposit Insurance Corporation, The Insurance Reserve Fund of the Federal Savings and Loan Insurance Corporation, the Mutual Central Savings Fund of Massachusetts (with a Deposit Insurance Fund and a Liquidity Fund), and the Maryland Savings Share Insurance Corporation (with a Deposit Insurance Fund and a Central Reserve Fund). In each of these examples, a central fund was created on an industry wide basis to meet the requirements of both the industry and State or Federal law. Participation in the funds is a requirement of operation within the industry.

An example of individual trust funds was found in the regulatory framework controlling the operation of cemeteries. In Virginia, for example, each cemetery has a perpetual endowment fund, with an initial deposit of $25,000 made by the cemetery operator. Interest from the fund is used for maintenance, security and perpetual care. The principal cannot be disbursed. The trust fund is increased by a minimum of 10% of the sale of each lot as long as the cemetery continues to sell lots.

Feasibility and Practicality

There appears to be no insurmountable obstacle to implementing a trust fund system within the hazardous waste management industry, the organizational effort would be considerable, especially if the trust fund were to be a central, industry wide fund. Potential objections to both the central fund and the individual fund approach are foreseeable. The individual trust fund would require larger original payments than a central fund, though they would be fully reimbursable. The central trust fund, though requiring less of an assessment, would have no refund. Furthermore, the more reliable licensees might object to having to pay the continuity of operation costs of those less reliable operators who abandoned their sites, particularly if there were no incentives at work to discourage site abandonment. Whether membership in the central fund is selective or not will have a major impact on the response of the industry to the possibility of establishing such a fund. Where the costs that the fund is expected to meet are predictable and will have to be met by all permit holders, an individual trust fund system seems most appropriate. Where the costs are unpredictable, the source of the need is unknown, and the need occasional and limited to a few members, a central trust fund is appropriate.

Generally, the trust fund provides the most effective way of ensuring that the largely predictable costs of closure and post-closure maintenance, security, operations, and monitoring are met for all sites, short of the assumption of this responsibility by the government itself.

c. Bond Requirements

Bonds are used when a regulatory or contracting agency requires some assurance that a contractor or licensee will carry out an activity according to the terms of the license or contract. It is a widespread device, and has been recently incorporated into many state regulations on hazardous waste. Bonds are used to guarantee the performance of an obligor over a specific period of time, usually no more than two or three years. Performance is defined very specifically. The bond issuer, such as a surety company, "stands in place of the principal" and pays the amount of the bond to the agency in whose name the bond was issued if the obligor fails to meet the performance requirements. Depending on the extent of non-performance, only part of the bond may be forfeited. The surety company then looks to the obligor for indemnification. Unlike insurance, a bond does not relieve the obligor of its obligations. Instead, bonds simplify for the agency the task of collecting the assessment for non-performance. The surety company serves as an organizing intermediary and, for a fee, relieves the agency of the trouble and uncertainty of collecting from the non-performer.

Bonds can be arranged in a number of different ways. Commonly, a surety company will issue a bond only when it is satisfied that the obligor has adequate assets to reimburse the surety company for the amount of the bond if it is forfeited. It the surety company is not confident that it will recover, the bond applicant may be required to put up collateral for the bond. The collateral may reach 100 percent of the bond value, a cash bond, and be held through the period of the bond. A surety bond is good for a specific period of time, e.g. the expected duration of a construction project or the duration of a license. Bonds are not issued for indefinite periods, but may be renewed by agreement of the parties involved.

Bonds are used to guarantee short-term rather than long-term performance. They are not designed to cover risks, and provide no mechanism for risk sharing. Surety companies do not ever expect to lose financially on any bond (unlike insurance where losses will be incurred on some policies, and profits made on others.) Fees charged for bonds cover the cost of evaluating the financial condition and performance record of the bond applicant, administration, and company profit.

Pros and Cons

Bonding is a well-known device to assure performance by permit holders and contractors. Its advantages are important. 1) Bonds will provide a near-absolute guarantee that the permit holder performs appropriately, or that the funds required to hire an alternative operator will be available (assuming the bond amount is calculated to cover the cost of the remaining functions.) 2) The bonding mechanism is relatively simple and already in place. 3) From a regulatory standpoint, bonding is a simple requirement to administer. 4) For those applicants who qualify for surety bonds and do not have to post collateral, bonds are a relatively cheap requirement. Bonding also presents a number of important disadvantages. 1) For the companies judged unbondable by the surety firms a 100% collateral will be required to meet the bond requirement, which may prove a serious obstacle or burden to the financially weaker firms, though they may otherwise be fully reliable and stable. 2) Bonds can guarantee performance over short periods of time only. They cannot have, in the words of the surety bond industry, "long tails." Thus bonds could be used to cover performance during the operational phase of a hazardous waste management site, and closure of the site. But a bond could not be posted at the time of closure to cover, say, an indefinite or long-term post-closure maintenance and security obligation. Bonding could cover post-closure functions on a year by year basis if the operator purchased the bond anew each year. 3) Bonds, typically, are only good for relatively short periods. Thus a hazardous waste management firm facing financial difficulties that jeopardize its future ability to fulfill its performance obligations may discontinue its bond, or, more likely, find that the surety company will not renew the bond, precisely at the time the bond is most needed. A firm facing these difficulties is almost certain to let the bond expire before it fails to meet performance standards, thus avoiding a forfeiture of the bond which would leave it liable to the surety company. A 100 percent collateral cash bond avoids this problem, but poses the problem of burden noted above. A surety bond provides an incentive to perform for the company that expects to continue in business. For a company going out of business, a surety bond provides no guarantee at all (though failure to renew the bond could signal the declining condition of the firm.)

Costs

Surety bonds and cash bonds have different types of costs. The costs of surety bonds are those of evaluating the applicant's reliability and financial stability, administering the bond, and the surety company's profit. The cost of a cash bond is the opportunity-cost of the collateral posted. This cost may be mitigated, if the collateral is in liquid form, by depositing it in an interest bearing account, due within the bond period.

Thus the costs of a cash bond are those associated with the full lump-sum approach described above. The costs of surety bonds depend on the charge for the surety bond. Using a surety bond rate of 1 percent of face value per year, Table 20 shows the total costs of meeting continuity requirements with a surety bond, both for firms ceasing operation with the closure of the site and for on-going firms. For a firm going out of business with the closure of the site, the total annualized costs over the life of the site are simply the annual costs of the surety bond plus the

Table 20

Total Annualized Costs of Providing for Continuity Through the Use of Surety Bonds and Internal Funds

per $100,000

		A	B	C
Life of Site		Real Interest Rate = .01 Real Opportunity Cost of Capital = .02	Real Interest Rate - .02 Real Opportunity Cost of Capital = .035	Real Interest Rate = .02 Real Opporunity Cost of Capital = .08
10 yrs	Firm closes with closure of site (End of Site Approach)	$10,100	$9,500	$7,900
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	8,400	7,700	3,600
20 yrs	Firm closes with closure of site (End of Site Approach)	$5,100	$4,500	$3,200
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	4,500	3,600	1,750
30 yrs	Firm closes with closure of site (End of Site Approach)	$3,500	$3,500	$1,900
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	3,000	2,400	1,300

Derivation: See Text

[a] Assumes 10% of the Fund is for shut down costs, the remainder for annual expenditures in perpetuity.

cost of the end-of-site approach. For on-going firms, the total cost of annualized surety bonds are the costs of the payment upon occurrence:

$$S\left(1 + \frac{1}{(1 + r_2)^L - 1}\right) F$$

where S is the cost the surety bond as a percentage of bond value.

The costs of a surety bond transformed into a cash bond will depend on the rate at which this transformation occurs. For a transition from a surety to a cash bond over the life of the site, the cost is equal to the cost of the annual payment approach plus the following term:

$$\sum_{0}^{L} S \left(\frac{F - \frac{r_1}{(1 + r_1)^L - 1} F}{(1 + r_2)\, t} \right)$$

For a surety bond rate of 1%, this will add between $500 and $1000 per year per $100,000 of fund size to the costs of the annual payment approach.

Implementation

Implementation by EPA of a bond requirement for hazardous waste management permit holders appears to present no significant problem. Bonds are a common feature of a number of State hazardous waste regulations already in existence. Nonetheless, bonding presents the drawbacks discussed above: A cash bond may be burdensome to a small firm because it ties up capital that might better be used on site development; a surety bond guarantees performance only during the life of the bond, and may not be renewed by a company on the decline, or by the surety company perceiving the decline of its client.

At least one state, Oregon, has found a way of threading between these two problems. Upon receiving its hazardous waste disposal license, the recipient must post a $75,000 surety bond. This is gradually transformed into a cash bond by means of annual cash payments of $18,750 the first year and $5,625 per year for the next ten years. The advantage of this system is that the least onerous of the two bond types is accepted during the early years of the site, when, because of its high earnings potential, it is least likely to be abandoned or prove uneconomical to operate. The more reliable and effective of the two bond types, cash bonds, are then in place when the need becomes greatest, i.e. when the site's closure is imminent; yet the cash bond was built up gradually, softening the financial burden that it imposes on the licensee. Of course, those applicants who are not able to secure a surety bond in the first place are still left with the difficulty of securing a cash bond immediately.

Feasibility and Practicality

As we have noted, implementing a bond requirement for the hazardous waste industry poses only the problem of burdening the unbondable companies with heavy collateral requirement. Generally, bonding is a well established practice. The surety industry is large and could meet the bonding needs of the hazardous waste industry, provided they are limited to specific performance standards, and to specific short periods of duration. Bonds become impractical when considered for long-term or perpetual care purposes. The bond would have to be maintained year by year, and so the extension through time of the bond would have to be matched by the longevity of the operator. To meet this need, a permanent fund is required, which allows for the eventual disappearance of the operator, but leaves a financial capacity behind to meet the residual obligations of the operator. Oregon's cash bond is designed to do this. The principal is calculated to generate enough interest to cover annual post-closure needs. The term cash bond is, in this case, a misnomer for it is not refundable to the obligor. It is, in effect, a permanent fund.

d. Escrow Requirements

Escrow requirements of possible use in the implementation of RCRA 3004 share many of the functional characteristics of cash bonds and trust funds for individual operators and sites. As used here, an escrow requirement would operate as follows. Funds would be set aside by the operator for a specified future use, and released either to pay for the use specified, or returned to the operator upon completion of continuity of operation responsibilities. Unlike the type of trust fund that might be set up for the long-term care of closed sites, an escrow requirement assumes the termination of the escrow, and of the problem that gave rise to the need for the escrow, within a predictable period of time. While this period may be longer than the 1-3 years typical of bonding schemes it is finite. An escrow requirement assumes the endurance of the entity putting up the escrow funds through the period when the escrow is dissolved.

Pros and Cons

As with cash bonds and trust funds, the principal advantage of an escrow system is that the funds for continuity of operations can be secured and isolated well in advance of the time at which they are likely to be needed. The funds would be gathered at a time when operator income is relatively high, and available for use when the economic interest of the operator in the site is at its lowest. An advantage of the escrow approach over cash bonds is the greater flexibility of the escrow. A cash bond is a forfeitable instrument, dependent on an evaluation of overall performance. Used as a guarantee of performance, bond forfeiture is in the nature of a punishment for substandard performance. An escrow account can be designed to support future performance directly, by supplying funds when they are needed to cover the costs of performance. The advantage of an escrow system over trust funds is that the escrow can be made directly refundable, and that the initiative for use of the escrow can come principally from the operator, with the escrow administrator's role limited to verification of performance. A trust fund requires the eatablishment of a separate organization to administer the funds and decide on their best uses.

The basic disadvantages of an escrow are its finite duration, and its requirement that operators set aside funds for future use, when they might otherwise be used for expansion, technological development, or profits.

Costs

Cost categories of an escrow system include cost of capital, opportunity costs, and administration. The costs would be equal to those of the full lump-sum approach normally, but might be those of the lump-sum-plus-interest approach if organized accordingly.

Implementation

There are few instances of escrow systems used for continuity of operation purposes within the hazardous waste industry. Kansas, which also has a non-refundable escrow account to cover long-term monitoring, has established an escrow system to guarantee closure and post-closure activities for ten years after closure. The escrow amount, $100,000, is made up of a $50,000 bond and $50,000 in deposits over an approximate period of ten years. The bond is returned to the licensee five years after closure; after ten years all remaining escrow funds are returned.

Feasibility and Practicality

Of the three basic approaches to securing and isolating funds for future uses -- bonds, trust funds, and escrows -- escrows appear the simplest system to implement. Bonds require the cooperation of a private sector intermediary, the surety company. Trust funds require the organization of an independent fiduciary, whose responsibilities require considerable technical knowledge and will be subject to potentially controversial policy issues. The escrow can be administered by the same organization that administers the licensee monitoring and evaluation program. However, the escrow approach cannot be used for perpetual care purposes.

e. Industry Mutual Assessment Requirements

A fifth approach to meeting the continuity of operation objectives of RCRA 3004 is to provide for mutual assessment by hazardous waste management industry members to cover the closure and post-closure costs of abandoned sites. These costs would be divided between each member of the mutual assessment association on a predetermined basis, each member being liable for its share of the costs.

The formation of a mutual assessment association within the hazardous waste industry would depend to a large extent on industry initiative. The association would have to take on a formal responsibility for abandoned sites, and each member commit itself to meeting its assessment. The definition of goals, standards, and coverage would have to be arrived at in cooperation with EPA, and be compatible with EPA RCRA 3004 responsibilities.

An important factor that will affect the formation of a hazardous waste mutual assessment association is the degree of homogeneity between potential members of the association. The potential risk of failure represented by each member is the key element. Low risk-of-failure licensees are unlikely to be willing to accept association with high-risk members, (the same problem confronting the establishment of an industry-wide central trust fund.) One solution is to differentiate between the levels of potential closure costs and post-closure hazard of the particular disposers and set assessment rates accordingly. An alternative solution might be the creation of a number of mutual assessment associations, representing different level of risk categories. Levels of risk are expected to range widely within the industry, reflecting the materials handled, disposal techniques, and site location. Size of operation is not likely to be an important obstacle, as the assessment formula could easily reflect licensee receipts, for example. As with the central trust fund concept, the question of whether an EPA hazardous waste management permit should be the only requireemnt for membership is raised by the mutual assessment association approach. The answer lies partly in the degree of effectiveness to be found in EPA permit standards and the stringency with which they are enforced.

The reliability and durability of the scheme chosen to guarantee continuity of operations objectives has been a key concern, due to the longevities of the hazard associated with hazardous wastes. A further aspect of the mutual assessment association approach is that the collective reliability of the industry would be used to guarantee the failures of its weaker members. However, if less than the whole industry belonged to the association, care would have to be taken to prevent associations consisting entirely of one site firms of approximately the same age.

For the sake of a timely response to the needs of an abandoned site, the mutual assessment association may establish a relatively small standing trust fund, calculated to cover the immediate costs of one or two new site abandonments.

To meet the long-term costs of the abandoned sites, the association could form a site specific trust fund, or continue to assess itself on an annual basis to meet its current obligations.

Pros and Cons

An industry-wide mutual assessment association has a number of advantages: 1) the initiative for self-administration will have come from the industry; 2) the industry will have a collective interest in the content, implementation, and enforcement of the EPA hazardous waste management regulations; and 3) the funds required to implement the assessment system will be not much larger generally than the costs of providing for those sites that are abandoned. If no sites were abandoned, no assessments would be required, conceivably for long periods of time.

The principal disadvantages of an industry-based mutual assessment association appear to be: 1) its dependence on the voluntary cooperation of industry members. 2) If site abandonment problems prove greater than expected, disintegration of the association may follow as the low risk members withdraw in favor of other schemes to meet EPA continuity objectives, such as individual operator trust funds. 3) The mutual assessment approach does not offer the strong incentives, present in some of the other approaches, for operators to meet their closure and post-closure obligations. 4) The waste management institutions of future generations may have to pay for the consequences of incorrect disposal procedures used by previous generations, if these consequences became evident long after the operational closure of a site.

Costs

The cost categories of a mutual assessment association include assessments per se, association management costs and trust fund capital costs (if implemented).

The basic analysis of costs for a mutual assessment association are similar to those of a centralized trust fund, with the key difference that a mutual assessment association need have no donations except when failures occur. In order to evaluate this option, Table 21 was generated showing failure rate below which membership in a mutual assessment association and the use of the end-of-site and payment upon occurrence approaches by non-failing firms is preferable to individual systems typified by the full lump sum approach. For a pure assessment association, the failure rates can be quite high and the association would still remain preferable to the full lump-sum approach. Combinations of a central trust fund and a mutual assessment association would become workable at failure rates between those shown for a centralized trust fund and an assessment association. One cost not shown here is the inherent risk of a large number of failures to which members of an assessment association are exposed, due to diminished performance incentives.

If all members of a mutual assessment association have equal probability of failing to meet their post closure requirements, then the annualized cost of a mutual assessment association are identical to those of the end of site or pay as you go methods (annualized costs are shown in Table 22). For higher costs of capital and longer site lives, the resulting annualized costs fall to less than 1 percent of annual revenues. The problems in forming such an association derive from the problem that different firms will have different probabilities of closure. This problem can be dealt with in part by charging different fees if there is any objective basis for making the assessment of probability of failure. One measure of the difficulty of forming such an organization is the difference in perceived closure rate such that, if all members are charged the same price, the firm would choose the deposit fund rather than be a member of the association. Table 23 presents a set of such difference in closure

Table 21

Failure Rates Per Site Per Year Below Which a Mutual Assessment Association Plus Internal Funding of Continuity Requirements is Preferable to a Full Lump Sum Approach

		A	B	C
Life of Site		Real Interest Rate = .01 Real Opportunity Cost of Capital = .02	Real Interest Rate = .02 Real Opportunity Cost of Capital = .035	Real Interest Rate = .02 Real Opportunity Cost of Capital = .08
10 yrs	Firm closes with closure of site (End of Site Approach)	1.0%	1.5%	6.0%
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	.9%	1.4%	5.7%
20 yrs	Firm closes with closure of site (End of Site Approach)	1.0%	1.5%	6.0%
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	.9%	1.3%	5.9%
30 yrs	Firm closes with closure of site (End of Site Approach)	1.0%	1.5%	6.0%
	Firm remains on-going after closure of site[a] (Payment Upon Occurrence Approach)	.9%	1.2%	5.9%

Derivation: For firms closing with the closure of the site, break even failure rate is simply equal to the differential between the full lump sum approach and the end of site approach. For on-going firms, break even failure rate is $f = \frac{d}{1 + \frac{1}{(1 + r_2)^L - 1}}$ where d is differential between the full lump sum approach and the payment upon occurrence approach.

[a] Assumes 10% of the Fund is for shut down costs, the remainder for annual expenditures in perpetuity.

Table 22

Annualized Cost (dollars per year) of a Mutual Assessment Fund
Assuming All Members Have the Same Probability of Closure
and Annual Post Closure Costs of $13,000 Per Year[a]

Life of Site		Real Interest Rate = 0.1 Real Opportunity Cost of Capital = .02	Real Interest Rate = 0.2 Real Opportunity Cost of Capital = .035	Real Interest Rate = .02 Real Opportunity Cost of Capital = .08
10 years	Firm closes with Closure of Site (End of Site Approach)	118,376	55,295	44,860
	Firm remains on-going after closure of site (Payment Upon Occurrence Approach)	58,654	44,571	11,215
20 years	Firm closes with Closure of Site (End of Site Approach)	53,367	22,867	14,224
	Firm remains on-going after closure of site (Payment Upon Occurrence Approach)	26,683	13,066	3,556
30 years	Firm closes with Closure of Site (End of Site Approach)	32,296	10,421	5,684
	Firm remains on-going after closure of site (Payment Upon Occurrence Approach)	16,148	7,145	1,421

Derivation:

End of Site = $\frac{r_2}{1 - (1 + r_2)^{-L}} (1 + r_2)^{-L} \frac{AC}{r_1}$ Pay as You Go = $\frac{r_2}{1 - (1 + r_2)^{-L}} (1 + r_2)^{-L} \frac{AC}{r_2}$

where r_1 = assumed real interest rate, r_2 = assumed real opportunity cost of capital, L = life of site, AC = Annual Post Closure Costs

[a] Costs are exactly the above if closure probabilities of each site are zero. Above approximate costs if all members have the same probability of closure and that probability is low.

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Table 23

Failure Rates Per Site Per Year Below Which a Mutual Assessment Association Plus Internal Funding of Continuity Requirement is Preferable to a Cash Deposit for Firms with Near 0 Probability of Failure

Life of Site		A Real Interest Rate = 0.1 Real Opportunity Cost of Capital = .02	B Real Interest Rate = 0.2 Real Opportunity Cost of Capital = .035	C Real Interest Rate = .02 Real Opportunity Cost of Capital = .08
10 years	Firm closes with closure of site (End of Site Approach)	.96	5.9	4.35
	Firm remains on-going after closure of site (Payment Upon Occurrence Approach)	1.0	2.2	5.1
20 years	Firm closes with closure of site (End of Site Approach)	.76	.73	4.11
	Firm remains on-going after closure of site (Payment Upon Occurrence Approach)	.92	1.1	4.5
30 years	Firm closes with closure of site (End of Site Approach)	.86	1.36	3.74
	Firm remains on-going after closure of site (Payment Upon Occurrence Approach)	.94	1.2	3.9

Derivation: For firm closing with the closure of the site (end of site approach, the break even failure rate is: $\frac{DF - EOS}{\frac{AC}{r_1}} \times 100$

For on going firms that choose to use the pay as you go approach the formula is: $\frac{DF - PG}{\frac{AC}{r_1}} \quad \frac{1}{1 + \frac{1}{(1 + r_2)^L - 1}}$

which assumes that payments to the mutual assessment association are required to make up for the continuing possibility of failure.

DF = Annualized Cost of Deposit Fund; EOS = Annualized Cost of end-of-site approach; PG = Annualized Cost of pay as you go approach; Other abbreviations as in above tables rate, depending upon real interest rates, opportunity cost of capital and life of the site.

Implementation

No mutual assessment associations exist within the hazardous waste management industry, nor do the State laws and regulations examined in this study make provision for meeting management objectives by means of such associations. The reasons for this may reflect the embryonic and as yet poorly defined character of the industry as a regulated entity, and the lack of communication and homogeneity within the industry itself.

The mutual assessment approach is used in several states to cover policy owner losses for insolvent insurance companies.

The efforts of the New York Stock Exchange to protect the public from the bankruptcy of Exchange members, described in some detail in the section of this report on financial responsibility, provided an interesting example of an industry based mutual assessment association. Between 1959 and 1964 the New York Stock Exchange assessed its members in order to cover the losses incurred by a small number of members who went bankrupt. In 1963, a bankruptcy resulted in an eventual $27 million loss, made good through member assessments. In 1964, to avoid such large ad hoc assessments, the Exchange established a trust fund system to meet the same responsibility.

Feasibility and Practicality

Implementation of a mutual assessment association within the hazardous waste industry will depend on the responsiveness of the industry itself to the responsibilities that EPA outlines for the industry. Lack of homogeneity of levels of risk within the industry may prove an insurmountable obstacle to a full development of this approach to meeting continuity of operations objectives. The members of the New York Stock

Exchange had a compelling common interest in maintaining the highest possible level of public confidence in the Exchange. The hazardous waste industry has no immediate comparable interest. Continuity of operation objectives in the hazardous waste industry may have to be met by schemes that reflect government rather than industry initiative.

If the industry were to respond, a mutual assessment association, probably combined with an emergency use trust fund, appears to offer a relatively cheap and effective method of meeting RCRA 3004 continuity of operations objectives.

2. Provide Access to Sites

The alternatives examined above are those that might be used to meet the objectives of continuity of operations that seek to guarantee performance of closure and post-closure responsibilities by the operators, or the funds required to carry them out if the operator abandons the site. A second objective of continuity of operations is to provide rapid, emergency access to a mishandled or an abandoned site. The alternatives considered here seek to provide this access. They include: RCRA §3008 and 7003; site transfer; and easement.

Section 3004 of the Resource Conservation and Recovery Act of 1976 requires that such hazardous waste management standards be established "as may be necessary to protect human health and the environment". To this end the physical behavior of hazardous wastes in a hazardous waste disposal site will be monitored, and operation of the site regulated to help ensure that no release of hazardous material that may endanger human health or the environment occurs. To meet this objective, rapid access to the site by responsible authorities will be required under two conditions: 1) the monitoring system indicates a release is taking or has taken place and there is inadequate indication that the site operator is responding properly; and 2) a site is abandoned and may release hazardous materials to the environment because of neglect. Access to the site must be of two

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f. RCRA Sections 3008 and 7003

Section 3008 of RCRA provides for federal enforcement of the RCRA Hazardous Waste Management requirements. The enforcement procedure provides 1) that a violator be notified of his failure; 2) if the violation extends 30 days beyond notification the Administrator may either issue an order requiring compliance within a specified time, or initiate a civil action for relief; 3) if the violation occurs in a state which maintains its own authorized hazardous waste program, the state shall be given 30 days notice prior to initiating civil action of issuing an order to the violator. 4) If the violator fails to respond to the order, he may be subject to a civil penalty of $25,000 for each day of continued non-compliance, and the violator's license may be suspended or revoked.

Section 7003 of RCRA provides for response to an imminent hazard. It provides that if a hazardous waste operation presents "an imminent and substantial endangerment to health or the environment, the Administrator may bring suit . . . to immediately restrain any person for contributing to the alleged disposal . . . or to take such other action as may be necessary". The Administrator is required to notify the affected State of any such suit.

Clearly, neither of these sections provide for the type of access needed to protect human health or the environment from the potential release of hazardous materials from a site that is being improperly operated, or one that has been abandoned. While access for fact-finding and site assessment is provided in another section (see § 3007), these sections do not permit access to correct hazardous conditions on site, nor do they provide for rapid or emergency access. It is somewhat unclear what purpose will be met in levying a daily fine against an abandoned site, or one whose operator has gone into bankruptcy. With these concerns in mind, a number of State regulations have sought to provide for more effective means of access. These provide for transfer of the site to State ownership, and for placing easements on the site.

g. Site Transfer Requirements

Under a site transfer requirement, ownership of the site would be transferred to State jurisdiction at a specified point in the history of the site. The transfer has a fourfold effect. 1) The State gains full access to the site, and can meet the emergency response need inherent in the requirement that sites be operated in such a way that human health and the environment be protected. 2) The State becomes fully responsible for the future operation of the site (which it may contract out to the private sector) and for continuity of operation and financial responsibility requirements. 3) The initial owner of the site is relieved of these same obligations, but may retain residual responsibility for events that took place during the period of ownership prior to the transfer of title to the State. 4) The State gains immediate control over alternative uses of the site.

There are three basic transfer schemes: each has advantages and disadvantages.

TRANSFER ALTERNATIVES	PRO	CON
1. Transfer at Time of Licensing	Access guaranteed over full life of site	Increased state responsibility
2. Transfer at Closure	Access and control guaranteed over post closure activities. Operator responsibilities end with termination of income from site.	Operator responsibilities for post closure site condition turned over to state
3. Transfer after a Period of Time Post-Closure	Operator not faced with obligations in perpetuities but ahs demonstrated adequate post-closure preparation of site	Operator has costs on site that no longer produces revenue; state assumes perpetual care obligations

Pros and Cons

Site transfer provisions may have two purposes. If the primary purpose of a site transfer requirement is to provide emergency access to a site to correct a hazardous condition, the requirement appears somewhat drastic. Providing long-term continuity of operations and financial responsibility for a hazardous waste site is not a trivial undertaking, and a State takeover requires the establishment of a substantial operational capability. If the purpose of a site transfer requirement includes relieving a hazardous waste firm of a perpetual burden incompatible with the uncertainties of a private enterprise economy, the requirement provides an appropriate method of doing so. The pros and cons of the requirement are therefore dependent on the objectives that are included in the continuity of operations framework.

The advantage of site transfer for purposes of providing access is that full access is assured without further legal effort and provides no delays, as exemplified by RCRA Sections 3008 and 7003. The disadvantages are that the State has had to assume total responsibility for *all* the present and future needs of the site including continuity of operations, which was intended by the transfers, and financial liability responsibility, which was not, for at least those releases that take place post-transfer.

The advantages of site transfer for purposes of terminating a perpetual burden are that individual hazardous waste companies will be able to close their books at the end of each fiscal year with statements of measurable liabilities and obligations outstanding, and that prospective entrants into the hazardous waste industry will not be deterred by the prospect of an open-ended -- and potentially catastrophic -- responsibility overshadowing their commitment. The disadvantage is that hazardous waste operators would be relieved of legal obligations that have traditionally been assumed by the private sector, only because the *structure* of the obligation is unusually onerous.

Costs

The costs of a site transfer requirement will vary widely on a site by site basis, reflecting the value of the land itself. Where the land is in a prime location (which could well be the case after 20 or 30 years of operation), the longevity of the hazardousness of the materials contained within the site low, and the alternate uses to which the land can be put numerous, the value of the land could be very high. The cost of the transfer, whether absorbed by the operator or met by the State could be substantial. Where the land was in an area of low land values with hazards of indefinite or perpetual hazard, and for which no economically important alternative uses could be allowed, the value of the land could well be negative, i.e. it could represent a net liability.

Implementation

There are three basic approaches to site transfer requirements. These are exemplified in the existing or proposed hazardous waste regulations of Washington, Oregon, and Wisconsin.

Following private sector difficulties in locating a site for permanent hazardous waste disposal, the State of Washington decided to purchase land directly. The site, located on land surrounding the Hanford nuclear facility, will be leased out by private bid to a contractor. Upon termination of the site operation contract, the State will assume responsibility for all post-closure obligations.

In Oregon, a successful hazardous waste management permit applicant is required to deed the land upon which the wastes will be disposed to the State of Oregon within thirty days of licensing. No provision is made for payment for the land.

Draft legislation in Wisconsin provides that a site operator retain full responsibility for ten years after closure of the site. At the end of this period the status of the site is to be reviewed, and a determination made whether it still represents a hazard or not. If it is decided that further long-term care is required the operator may choose either to continue providing that care, or to sell the land to the State, which then assumes full responsibility for the site. The selling price is to be based on the fair market value of the site.

Feasibility and Practicality

There appear to be no inherent major obstacles to implementing a site transfer requirement in the hazardous waste industry, provided there is a recipient agency that can effectively and economically carry out the full range of functions associated with the closure and post-closure needs of the facilities. State liabilities would have to be defined, and would probably be reflected in accompanying legislation. However, site transfer requirements may, in some interpretations, clash with the intent of that part of RCRA Section 3004 that prohibits the criteria developed for ownership, continuity of operation and financial responsibility from precluding private entities "from the ownership or operation of [hazardous waste] facilities" where the entity can provide assurances that it can meet financial responsibility and continuity objectives. Site title transfer after the useful life of the site is evidently compatible with this condition, as closure and post-closure requirements clearly pose challenges that may exceed the institutional capabilities of operators. But mandatory transfer before that time precludes ownership, though, as indicated by the approval of the license application, it is recognized that the operator is capable of meeting continuity of operation and financial responsibility requirements.

If the purpose of a site transfer requirement is to ensure prompt and effective access to a site rather than to relieve hazardous waste firms of unusually long-termed and indefinite obligations, a less drastic alternative may be found in the form of easements.

h. Easement Requirements

An easement grants to non-owners specific rights on a piece of land. Typically, an easement provides transit rights to land owners who must cross the subject land to get to their own property. Easements can be drawn up to cover a wide range of rights, and can run with the property, i.e. they convey with the property at time of sale. Easements are a simple mechanism for tempering the unlimited control a property owner typically has over access to his property.

For purposes of ensuring continuity of operations at a hazardous waste disposal site, the site owner could be required as a condition of his permit to grant an easement providing for immediate access by the proper authorities to the site for monitoring, evaluation, and corrective operations.

Pros and Cons

The advantage of an easement approach to the access problem is that it provides an effective mechanism at no cost and minimal institutional disruption. A potential disadvantage is that in the rare cases where the owner is hostile to remedial action by regulatory authorities and bent on obstruction, the owner could constrict the range of actions that the environmental and human protection authorities might wish to take. Judicial intervention might be necessary to permit long-term, large-scale intervention.

Costs

The cost of establishing an easement would be insignificant.

Implementation

Of the regulations examined, only one, Kansas, requires an easement of its hazardous waste management permit applicants. Kansas provides that the permit applicant execute an easement that authorizes the Kansas Department of Health and Environment representatives to: 1) complete unfinished site closure work; 2) perform work for which surety has been provided; 3) sample, repair or reconstruct monitoring facilities; and 4) require the operator to preserve and protect monitoring facilities. In this respect, the Kansas regulation offers a model of how an easement could be used to secure access to a site for continuity of operation purposes.

Feasibility and Practicality

Easements present no implementation problems, and appear to provide an effective means of ensuring adequate access to sites for continuity of operations purposes in all but the most difficult cases, where an owner decides to oppose intervention actively. Court intervention to uphold the easement would then be necessary.

3. Regulate Alternative Uses of Sites

The alternatives examined so far are those that seek 1) to guarantee closure and post-closure performance by operators or the funds to pay others to carry out those activities, and 2) to provide the authorities with adequate access to sites that present a threat to human health and the environment, and/or to terminate perpetual operator obligations to closed sites. A third category of alternatives could be used to control the various uses to which the site of a closed hazardous waste disposal operation might be put. The alternatives considered are covenants and zoning.

Different types of sites will have different requirements in this respect. Some sites may be available for any alternative use after a relatively short waiting period. Other sites might be available for only the least disruptive uses, such as golf courses, in perpetuity.

i. Covenant Requirements

A covenant is, typically, a condition imposed upon a buyer of land by the seller, restricting in a specific way the freedom of the buyer or his successors in title to use or develop the land. For instance, a new property buyer may agree for himself and subsequent buyers not to put up a television antenna on his roof, or to paint his house other than a natural earth color. Often, covenants are a condition of sale required by a residential developer to ensure that a certain style is maintained throughout his development. Covenants, once imposed, survive subsequent title transfers. Redress for a covenant violation may be sought through the civil courts. The sanction may be court enforced performance of the required standard or forfeiture of title to the original seller.

In the hazardous waste industry, covenants might be used to restrict the future uses made of a closed site, by requiring that the permit applicant establish a covenant against improper future use of the proposed site. The covenant could prohibit use of the land in ways that might so disturb the site after closure as to release hazardous material.

Pros and Cons

The advantage of a covenant approach to the problem of controlling post-closure uses of hazardous waste disposal sites lies in its relative simplicity. The disadvantages are 1) that covenants typically are used to moderate relations between private parties, and 2) that a covenant requires a specific definition of what is being prohibited or required of a property owner. As the acceptable uses to which a closed site might be put would vary with the actual waste inventory in the site, it is not clear that sufficient specificity could be given to a site at the time the site was inaugurated. An agreement to subject future users to a covenant, drawn up at closure, could be adequately specific, but the earlier uncertainty over what that covenant might specify could lead to owner-agency disagreement.

Costs

The costs of implementing a covenant scheme would be negligible.

Implementation

Of the State hazardous waste management regulations examined, only Kansas has a provision for a covenant. It is to be issued by the permittee, and specify post-closure uses of the site.

Feasibility and Practicality

There appears to be no obstacle to implementing a covenant requirement in the hazardous waste industry. However, because such an agreement would require a high degree of specificity it might leave too little room for administrative control and flexibility. A zoning approach, in which alternative uses are specified by broad categories, might be more effective than a covenant.

j. Zoning Requirements

Zoning is a technique used to control land use patterns. Broad use categories (such as residential low density; mixed residential-commercial; heavy industry, etc.) are defined and applied to given areas. Only those activities compatible with the zoning category are allowed within each area. For hazardous waste site protection purposes new categories may have to be created that would prohibit any activity, say, that required disturbing the ground below a specified depth. Golf courses could be allowed, but high-rise buildings prohibited.

Pros and Cons

The main differences between the zoning and covenant approaches are that zoning is done by municipal or county government, rather than by private parties, and sets forward broad criteria against which individual land-use applications can be evaluated. Enforcement of zoning is the responsibility of the local government. The initiative for enforcing covenants must come from other private parties whose rights under the covenant have been breached. Each of these differences represent an advantage to the zoning approach. The disadvantage of zoning is that it requires the formal involvement of the local land-use authorities. In unincorporated areas, where a significant number of hazardous waste sites are located, or where the zoning approach to land use planning has been rejected, this authority may not exist.

Costs

The costs of implementing a zoning mechanism for controlling the land-uses of closed hazardous waste sites are probably limited to the administration of land-use applications. Integrated into existing zoning systems, the costs are unlikely to be significant. Costs might be substantial to implement a zoning mechanism in areas in which there are no zoning authorities.

Implementation

No examples of the zoning approach were found in the State hazardous waste regulations examined during the study.

Feasibility and Practicality

In areas where a zoning authority already exists, the addition of a zone category for hazardous waste sites would be quite easily provided with the help of the local authority concerned in the Federal regulatory scheme. In other areas it might require the provision of a new authority, or the extension of an existing one beyond present boundaries.

F. Continuity of Operation Objectives and the Most Effective Ways of Meeting Them

Clearly, some of the methods that might be implemented to help meet continuity of operation objectives will prove more effective than others. Based on the evaluations described above, the methods that are likely to prove most effective may be summarized as follows:

Continuity of Operation Objective	Effective Methods of Meeting Objectives
1. Continuity during operations	1. Cash bond 2. Surety bond 3. Trust fund (immediate lump-sum)

Continuity of Operation Objective	Effective Methods of Meeting Objectives
2. Closure	1. Cash bond 2. Trust fund (from principal) 3. Escrow 4. Surety bond
3. Post-closure: annual expenditures (maintenance, monitoring, operations, security, etc.)	1. Trust fund (from interest earnings) 2. Industry mutual assessments 3. Escrow (from interest earnings)
4. Post-closure: extraordinary, unpredictable expenditures (liability, implementation of contingency plans, clean-up of release, etc.)	1. Trust funds (interest earnings to pay premiums for liability insurance) 2. Industry mutual assessments (interest earnings to pay premiums for liability insurance)
5. Termination of operator responsibilities	1. Title transfer to state
6. Access to site	1. Easement 2. Title transfer to state
7. Control of future uses of site	1. Zoning 2. Covenant

The most challenging set of objectives are 1 through 4, covering continuity during operations, closure, post-closure annual expenditures, and post-closure extraordinary expenditures. Two basic schemes, "A" and "B", emerge from our examination of the alternatives. Each involves a combination of two methods: a surety bond and a trust fund. Variations between the two are shown in italics. A third scheme, "C", combines some of the features of "A" and "B".

	Scheme A	Scheme B
1. Continuity During Operations	A surety bond would be required of all licensees at the time the license was granted. (If a surety bond was unavailable, a cash bond would have to be posted instead.) The sum of the surety bond would be if forfeited, sufficient to cover the costs of site closure *and provide interest adequate to cover post-closure requirements*. These costs could be estimated on a site by site basis. During the first few years of site operation (e.g. five years) the licensee would make annual payments into a *site specific trust fund so that by the end of the period the trust fund equalled the amount of the surety bond. During this time the amount of the bond would be decreased, so that the total value of the bond and the trust fund equalled the sum required to cover the costs of closure and post-closure*	A surety bond would be required of all licensees at the time the license was granted. (If a surety bond was unavailable, a cash bond would have to be posted instead.) The sum of the surety bond, if forfeited would be sufficient to cover the costs of site closure *only*. These costs could be estimated on a site by site basis. During the first few years of site operation (e.g. five years) the licensee would make annual payments into an *industry, State, or EPA administered central trust fund. The total size of the central trust fund would equal the estimated yearly costs of providing continuity of operations within the industry for abandoned sites. The payment of each licensee could be prorated to licensee income. The central trust fund, which would be deliberately kept as small*

	Scheme A (cont'd)	Scheme B (cont'd)
	requirements, the latter funded from the interest generated by the site trust. (See further explanation below, Figure 2.)	*as possible to reduce costs to the members, would be backed up by a mutual assessment industry association. The surety bond would be retained through the time of closure.*
2. Closure	The licensee would be responsible for site closure. *Upon carrying out this requirement the licensee would be reimbursed the prearranged amount alloted for closure and deposited in the trust fund.* If the licensee failed to close the site, *funds would be used from the site trust* to pay a contractor to close the site.	The licensee would be responsible for site closure. *No reimbursement would be made the licensee. The surety bond would be terminated following closure.* If the licensee failed to close the site, *the surety bond would be forfeited* and applied to the cost of hiring a contractor to close the site. *If the bond has expired, funds would come from the central trust fund and mutual assessment association.*
3. Post-Closure Annual Obligations	The licensee would be responsible for post-closure requirements (subject to possible termination of responsibility provisions.) *Upon carrying out each of these requirements, the licensee would be reimbursed the prear-*	The licensee would be responsible for post-closure requirements (subject to possible termination of responsibility provisions.) *No reimbursement would be made the licensee.* If the licensee failed to carry out post-closure

	Scheme A (cont'd)	Scheme B (cont'd)
	ranged amount alloted for each post-closure function and deposited earlier in the trust fund. If the licensee failed to carry out post-closure functions, *funds would be used from the stie trust* to pay for a contractor to perform the required functions.	functions, *funds would be used from the central trust fund and mutual assessment association* to pay for a contractor to perform the required functions.
4. Post-Closure Extraordinary, Unpredictable Obligations	Extraordinary potential liability obligations are translated into annual payments by means of liability insurance and its premiums. The licensee is responsible for premium payments (subject to termination of responsibility provisions). The premiums to cover abandoned sites are paid by the *site trust fund, which becomes the insured entity.*	Extraordinary potential liability obligations are translated into annual payments by means of liability insurance and its premiums. The licensee is responsible for premium payments (subject to termination of responsibility provisions). The premiums to cover abandoned sites are paid by the *central trust fund and mutual assessment association,* which becomes the insured entity.

Scheme C

A further alternative, *Scheme C*, might adopt the provisions of Scheme A for Continuity of Operations, Closure and Post-Closure Annual Obligations, and the provisions of Scheme B for Post-Closure Extraordinary Obligations, thus combining a surety bond with both an individual site trust and a central trust/mutual assessment association.

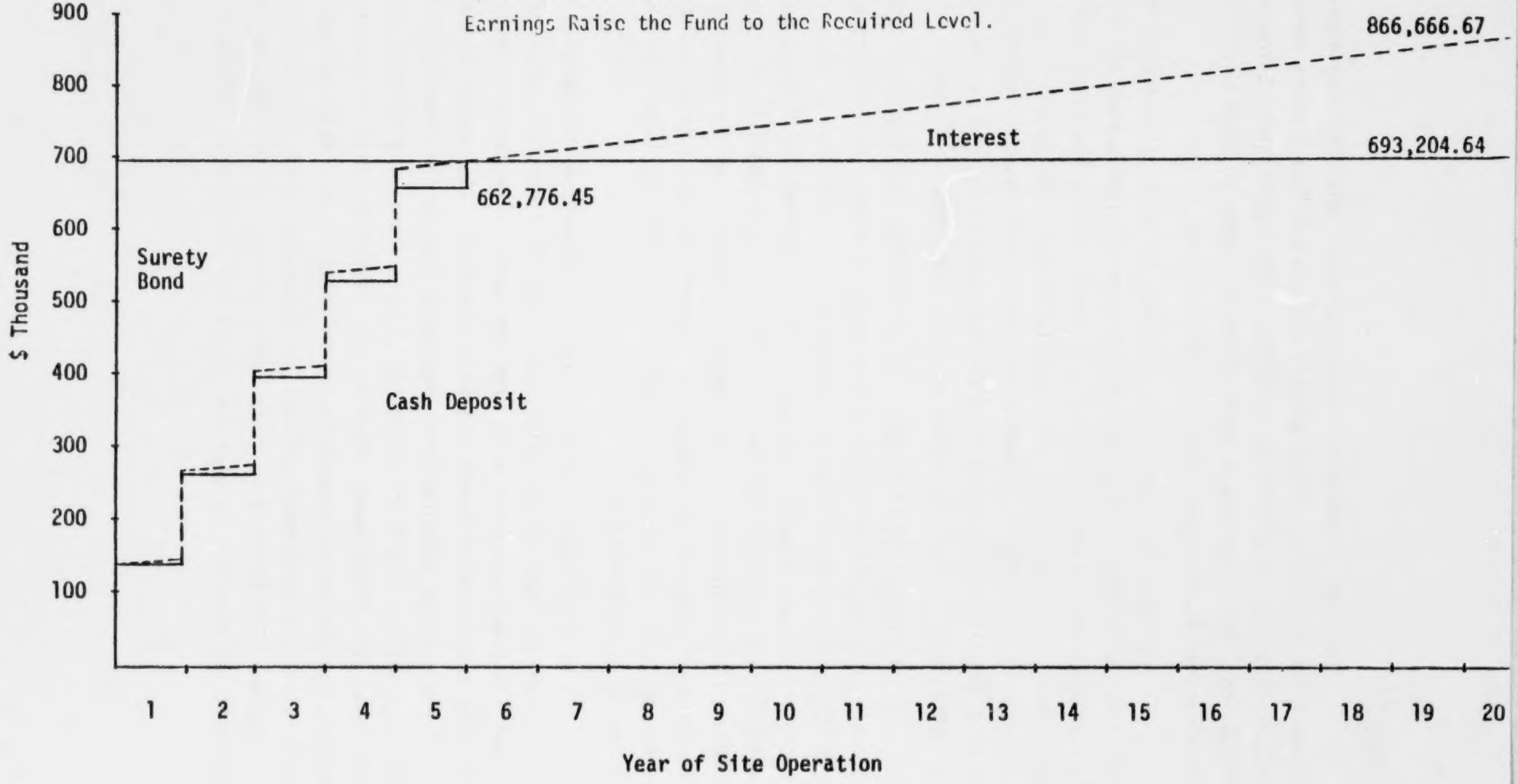
The basic fund scheme, as outlined in "A" is illustrated in Figure 3. Cash deposits are made by the permit-holder during the first five years of operation. A surety bond covers during the first four years the difference between the accumulated cash deposit and a sum adequate, with interest, to meet post-closure site costs in perpetuity. In this example, a site trust fund of $866,667 is required at the end of the operational life of the site, which is estimated at 20 years.

The objective of Scheme B is to minimize the financial impact of these requirements on the hazardous waste industry, while meeting the basic RCRA 3004 continuity of operations purpose. The selection of this regulatory scheme appears reasonable: it should meet the RCRA purpose of protecting human health and the environment without imposing an undue hardship on the hazardous waste management industry, or the generators of hazardous waste, or on consumers. However, as with any scheme that may be contemplated, it reflects a number of tradeoffs and faces significant obstacles to implementation.

As noted above, the objective of scheme B, which features a surety bond during site operation, and a central industry trust fund and mutual assessment association to meet the needs of abandoned sites, is to minimize the financial burden placed on industry. The concomitant is that it places a larger organizational responsibility on the industry as a whole, to police itself on continuity of operations, and to share the cost when that breaks down. Whether the "hazardous waste management industry" has sufficient cohesion and similarity of interests and needs to form such an industry institution(s) is a question that only the industry can answer. The alternative is to impose a scheme on the industry that reflects its inability to organize itself for continuity purposes. The

Figure 3

Post-Closure Cost Deposit: Surety Bond and Cash Deposit Schedule for a Fund of $866,667 at Closure, Assuming a 20-Year Operational Life. Cash Deposits Total $662,776. Interest Earnings Raise the Fund to the Required Level.



scheme, which would probably be similar to "Scheme A," would necessarily place a substantially larger financial bruden on each operator. A second potential drawback to Scheme B is that it removes the financial incentive of an operator to continue post-closure operations. In Scheme B, industry peer-pressure and the inherent responsibility of operators offer the main assurance of continuity. Scheme A provides such assurance through the set-aside of significant sums of money that are reimbursable to the operator only upon performance of continuity functions. The fall back position to Scheme B is Scheme A.

The cost of a Scheme A system, annualized over the life of the site depends upon the real interest rate chosen, the cost of capital to the firm, the life of the site, and the size of the post closure operating costs. Using the assumption that 13,000 dollars per year is required for post-closure monitoring and operations, Table 24 shows the annualized cost of the system proposed for various combinations of site life, assumed real interest rate, and cost of capital. The cost of the gradually declining surety bond is included in these calculations, but in no case constitutes more than 2.5 percent of the annualized costs. For a typical site with revenues of one million dollars a year, these annualized costs would call for cost increases of from 3 to 13 percent to avoid a decline in profits. The economic impacts of such a cost increase would need to be evaluated as part of an economic impact analysis, but it should be noted that other industries have been forced to bear costs of a similar magnitude in other regulatory programs.

Further these apparent costs may be reduced by the provision allowing for the assumption of responsibility by the Federal of State government, as discussed above, with a return of that portion of the fund allocable to insurance costs. Table 25 shows the size of this offset if 100 percent of the fund were to be returned (for the effect of returning the insurance portion of the fund, the percentage of costs represented by insurance should be multiplied by the offset shown in the table). For firms with either short lives or low cost of capital, this offset could be considerable. For the more likely case of longer lives and higher

Table 24

Annualized Costs of the Proposed Surety Bond and Cash Deposit System:
Assuming Annual Post Closure Operating and Monitoring
Costs of $13,000 Per Year
(dollars per year)

	A	B	C
Life of Site	Real Interest Rate = .01 Real Opportunity Cost of Capital = .02	Real Interest Rate = .02 Real Opportunity Cost of Capital = .035	Real Interest Rate = .02 Real Opportunity Cost of Capital = .08
10 years	130,909	93,670	73,143
20 years	63,342	27,469	41,001
30 years	43,494	19,282	30,018

Derivation:

$$\text{Annualized Costs} = \frac{r_2}{1 - (1 + r_2)^{-L}} \sum_{t = 0}^{4} \frac{AP + .01 \sum_{t=0}^{4} [(1 + r_1)^{-L+5} \frac{AC}{r_1} - \sum_{t=0}^{4} AC\ (1 + r_1)^{t}]}{(1 + r_2)^{t}}$$

where r_1 = assumed real interest rate
where r_2 = assumed real opportunity cost of capital
where L = Life of Site
AP = Annual Deposit Fund Payment
AC = Annual Post Closure Costs

Table 25
Annualized Benefits to Cost if Entire Fund is Returned 10 Years After Closure
(dollars per year)

	A	B	C
Life of Site	Real Interest Rate = .01 Real Opportunity Cost of Capital = .02	Real Interest Rate = .02 Real Opportunity Cost of Capital = .035	Real Interest Rate = .02 Real Opportunity Cost of Capital = .08
10 years	97,109	39,200	20,778
20 years	43,779	16,210	6,588
30 years	26,494	8,930	2,632

Derivation:

$$\text{Annualized Benefits} = \frac{r_2}{1 - (1 + r_2)^{-L}} \quad \frac{AC}{r_1} \quad (1 + r_2)^{-(L + 10)}$$

where r_1 = assumed real interest rate

where r_2 = assumed real opportunity cost of capital

where L = Life of Site

AC = Annual Post Closure Costs

Benefits of insurance rebate for insurance costs less than 100% of annual costs, simply multiply above by fraction representing insurance costs.

cost of capital, the resulting offset would be only a small percentage of total annualized costs. One problem in dealing with this offset should be noted however. If real interest rates are significantly below those used to calculate fund size, the government may need to retain all of the fund or even ask for additions to it in order to insure that adequate funding remained for expenditures other than insurance.

G. Ownership Requirements

RCRA §3004(6) calls for the issuance of such regulations of ownership requirements as may be necessary or desirable. It is a commonplace response of individuals and organizations , exposed to high risks of potential liability, to attempt to shield some or all of their assets from potential claimants. So, for example, it is a widely held belief that police officers regularly transfer all their assets to other members of their families to defeat attachment process arising out of claims of false arrest or official misconduct. Suspicion of a plan to accomplish a similar result underlay the unsuccessful Federal criminal prosecution of Allied Chemical Corporation for alleged conspiracy to avoid liability in setting up Life Sciences Corporation of Hopewell, Virginia, to manufacture the pesticide, Kepone. At least one of the major hazardous waste disposers currently in operation utilizes an extremely complex set of interrelated subsidiaries in operating an essentially unitary integrated business. Different sites are owned by different subsidiaries. A special subsidiary owns and operates most of the vehicles. Another subsidiary, with no significant assets of its own, conducts the actual operations. There is no implication of intentional misconduct. The organization exercises a high degree of care and advanced technologies in its operations and has an excellent reputation with EPA. Nevertheless, there is at least ground to infer that the organization seeks to partition its assets in such a way as to give some protection in the event of catastrophic loss.

The possibility of such a structure being adopted as part of an intentional pattern of misconduct was also raised in the course of several interviews. Two insurance industry representatives from New Jersey reported that in that State, the waste management industry generally, and the hazardous waste management industry in particular, included firms affiliated with organized criminal activities. Whether these reports were reliable or not, the possibility still exists that individuals entering the hazardous waste disposal business might meet permit requirements for closure and post-closure planning without intending to carry out the required plans. Such permit holders might contrive to harvest the profits from active stie operation while making preparations to transfer these profits and to abandon the site, as soon as the site was filled to capacity.

A second problem associated with ownership is the possibility that a waste disposer might utilize a rented site over which he would have no authority after termination of his lease.

For the foregoing reasons, it would appear that requirements preventing the insulation of corporate assets from claimants and ensuring the government the opportunity to gain access to a non-complying site, may be necessary or desirable. The most straightforward regulation to achieve that end would be a requirement that the organization obtaining the permit own all of the land used for waste disposal outright, as in "fee simple" as well as the assets in cash, buildings, vehicles and facilities used in the operation for which the permit is issued. In the alternative, where a permit holder chooses to lease equipment or buildings or otherwise to make use of assets not the property of the permit holder, it would be required to file proof of financial status showing current net assets in excess of the value of the rented utilized equipment or real estate, or a guarantee in a like amount of an affiliated corporation able to make such proof of financial status. Under such circumstances it should also be required to show that its authority to control and have access to the land will extend beyond the biologically active life of the wastes to be disposed of on the land.

"Fee Simple" is a term denoting unqualified ownership of land; unlimited as to duration. It distinguishes land held outright by a single owner and subject to disposition by at his sole discretion from land that is held under lesser forms of ownership or possessory right such as a lease, ownership by a trustee in trust for another, occupation by a life-tenant of property in which the remainder interest passes to another at the life tenant's death, or tenancy-in-common or joint tenancy with others.

In general, the requirement that a permit holder own land in "fee", "fee simple" or "fee simple absolute" does not mean that it cannot be mortgaged in most states. Originally, under its common-law interpretation, a mortgage required a conveyance of legal title in the land to be mortgaged to the lender. The borrower, or original owner, retained only an equitable right to compel a re-conveyance of legal title back to him when he paid off the debt. Today, in most jurisdictions, positions are reversed. The borrower keeps legal title to his land when he mortgages it, but the lender gets a security interest or lien upon the land that can be legally enforceable.

The possible requirement that permit holders own land in fee simple is not intended to prevent permit holders from mortgaging their land but to ensure that the permit holder has absolute control over disposition of the land and so can place enforceable restrictions on the potential buyer of his closed site.

Chapter III

CONTINGENCY PLAN STANDARDS

A. Introduction

Section 3004 (5) of RCRA requires owners of hazardous waste management facilities to develop contingency plans for effective action to minimize unanticipated damage from the treatment, storage or disposal of hazardous wastes.

This chapter sets forth possible contingency plan standards, the associated relative costs that would be incurred by owners and operators of hazardous waste facilities, and various strategy options for the implementation of these standards.

Contingency plans are formulated in advance of emergency situations that could occur at a hazardous waste management facility. The standards against which proposed contingency plans are to be measured are presented in Part "C" of this chapter. The approach used to develop them is explained in Parts "B" and "C". Although there is a general lack of literature on contingency plan standards, the Nuclear Regulatory Commission (NRC) has addressed the problem in developing such standards for use in handling nuclear wastes and has set forth comprehensive contingency plan standards. The contingency plan standards presented here have been grouped into the same general categories used by NRC: organization, communication, assessment and response/recovery.

The proposed standards and associated costs are based on scientific and engineering judgement and employ best estimates of present day costs incurred in the establishment of such standards.

Before the standards could be written, an evaluation and integration of all facility, event and waste types had to be made. Part B summarizes this procedure. Once all possible facility-event-waste groupings had been developed, appropriate contingency plan standards were written. Associating the various standards with the facility-event-waste groupings highlighted certain conclusions. Specifically, all standards were found to be virtually independent of hazardous waste type. Standards are directly related to the environment (i.e., atmosphere, subsurface water, etc.) into which a given release occurs. Although some standards relate more to specific events such as fires and explosions, the majority of standards apply "universally" to all facility-event-waste groupings.

After the contingency plan standards were completed, relative costs for implementation of the standards were developed. These are costs incurred by the owner for necessary measures or actions required in the event of hazardous waste release. The relative costs incurred are dependent on facility type, size and annual production. The two general facility types addressed are incinerators and landfills.

Four sets of strategy issues to be resolved before implementing contingency plan standards were examined to determine the advantages and disadvantages inherent in each strategy.

Finally, three sets of contingency plan standards were selected and an overall evaluation of each set was made with regard to its advantages and disadvantages. The three sets were intentionally chosen to present a wide range of possible alternative standards.

B. Evaluation and Integration of Facilities, Events, and Waste Types

The procedure employed in the development of contingency plan standards was a detailed review of all pertinent literature and available data concerning hazardous waste management facilities, an identification of the conceivable events (including natural disasters) that could occur at such facilities, and an examination of the various hazardous waste types that have been or are being treated, disposed of, or stored at such facilities. An effort was made to identify by this procedure all possible combinations of facility, event and waste types.

Appendices 3, 4, and 5, on facilities, events and wastes, respectively document the results of these investigations and elaborate on the procedures used in arriving at the results. Summaries of these findings are presented here.

1. Facilities

Available information on hazardous waste management techniques and present technology indicates that only certain disposal facilities or final treatment methods can provide effective treatment, storage or disposal of hazardous wastes, without having adverse effects on the environment. Thus, only those disposal facilities or final treatment methods likely to be deemed suitable for the treatment, storage and disposal of hazardous wastes were evaluated. Disposal facilities include landfills, incinerators, deep well injection, waste lagoons or ponds, land burial at depth, near-surface land burial and above surface storage. Final treatment processes include oxidation/reduction, neutralization, chemical degradation, detoxification, open burning, detonation, hydrolysis, biological degradation, and resource recovery.

Landfills

Landfills that may potentially hold hazardous wastes are termed secure landfills. These must isolate their contents from the environment, without compromising air and water quality. Other types are approved landfills, in which inert solid wastes and decomposable organic materials must be separated from underlying or adjacent usable water; and general landfills that can contain water along with the wastes. Sites fully meeting the specifications for secure landfills will be extremely limited under certain geologic and hydrologic conditions.

Incineration

Incineration is a controlled process that utilizes some type of combustion/burning process to convert a waste to less bulky, less toxic, or innocuous gas, liquid and/or solid. Incinerators can be used to dispose of combustible solids, semi-solids and concentrated liquid wastes. In general, carbon dioxide, water and ash (of various compositions) are the major constituents of incinerator products. When the combustion product contains undesirable compounds such as toxic hazardous waste gases (i.e., hydrogen cyanide), additional treatment such as afterburning, scrubbing, or filtration is necessary. Subsequently, the solid and liquid effluents, for example toxic inorganic oxides, are either treated further or disposed of at a hazardous waste facility, such as a secure landfill. In some instances, by-products, such as hydrogen chloride or lead slag, are recovered during the incineration process and recycled.

Deep Well Injection

Subsurface disposal of liquid wastes (deep well injection) has been practiced for many years. The mining and oil industries have used deep wells for the disposal of oil field and chemical brines. The major industries that dispose of hazardous wastes by deep well injection today include the chemical, petrochemical and pharmaceutical industries. These industries inject solvents, corrosives, heavy metals, pesticides and other hazardous wastes as liquids, which usually are pretreated prior to disposal. Injection wells in the United States generally range in depth from 1,000 to over 12,000 feet (Warner 1973). Treated wastes are injected by gravity flow or under pressure into subsurface strata that contain non-potable brackish or briny waters. Receiving strata must be bounded above and below by confining strata, such as clays and shales, to preclude any migration to and eventual contamination of potable water supplies. The composition of the hazardous waste is usually altered by pretreatment processes to insure that the wastes are compatible with the existing waters and subsurface environment, thus minimizing the possibility of clogging the injection zone. Inasmuch as earlier laws focused on the potential pollution of surface waters and only indirectly addressed the problem of ground-water pollution, disposal by deep well injection has gained in popularity among waste generators. However, deep well injection is likely to be deemphasized in favor of incineration and secure landfills under the new EPA RCRA standards.

Waste Lagoons and Ponds

Waste lagoons and ponds can consist of small concrete tanks or large excavated basins several acres in area. If a natural impervious material is absent at the base of the excavation, the larger facilities must be lined with relatively impermeable natural or synthetic liners such as clay, asphalt, concrete, or plastic to preclude the migration of hazardous wastes to the subsurface environment. Also, routine monitoring and detection systems such as wells, usually need to be installed along with diversion structures (trenches, berms, etc.) to intercept surface water runoff from surrounding areas.

Ideally, lagoons and ponds are located in geographical areas where favorable climatic conditions prevail. Such areas include those where evaporation rates are high and precipitation is low. The organic chemicals, pesticides and tannery industries are some of the major industries that dispose of hazardous wastes in various sizes and types of lagoons and ponds (EPA, 1976f; 1976k).[†††]

Near-Surface Land Burial

In near-surface burial, the hazardous waste is placed directly into the ground or is deposited in a variety of stainless steel tanks, concrete lined pits or a combination of these devices beneath the ground (Powers,1976). Although the hazardous wastes can be in a liquid or solid form, generally prior to burial, the wastes are converted to a solid form (i.e. by cementation, solidification, etc.) to reduce the mobility of the hazardous wastes in the subsurface environment.

Presently, near-surface burial of various hazardous wastes from the chemical industry is being conducted at several sites.

Various types of monitoring devices are installed, depending on the type of hazardous waste, to detect any leaking or leaching to the subsurface environment. Trenches are usually equipped with drains and pumps to capture potential leakage.

[†††] References for Chapter III are listed at the end of the Chapter.

Land Burial at Depth

Burial in deep subsurface openings is not widely practiced. Serious consideration is being given to this method, especially for radioactive wastes.

Above-Surface Storage

Small quantities of hazardous wastes might be stored in tanks, vaults or other containment devices, on or above land surface, until the wastes are collected and transported to another type of hazardous waste disposal facility. These wastes might include highly toxic organic chemicals and pesticides or lethal gases that may eventually be disposed of at other hazardous waste facilities, such as deep injection wells or incinerators.

Final Treatment Processes

In this report, a "final treatment" process is defined as one which alters or destroys hazardous wastes completely, leaving only innocuous substances whose by-products do not adversely affect the environment. The wide variety of treatment processes provides a broad range of treatment capabilities for the numerous hazardous waste types generated by industry. For the most part, these processes are performed by hazardous waste generators and often are incorporated directly into the processing plant system.

2. Events

The purpose of this section is to describe a classification of accidents or events whose occurrence at hazardous waste treatment, storage or disposal facilities might require emergency response measures. In this report, the words "accidents" and "events" are synonymous. Only events which relate directly to confirmed releases are considered. Natural disaster warnings, (e.g., for tornados and hurricanes, etc.) will be covered under RCRA §3004 operating plan regulations, not under contingency planning. A more detailed discussion of the events classification is presented in Appendix 4.

Non-routine Liquid Release

Liquid releases are divided according to cause of release (i.e., event subcategories): seepage, failure, or personnel error. These three groups are then further broken down into surface and subsurface groups since detection and response for these two types of release will differ significantly.

Non-routine Solid Release

Non-routine solid releases can occur at any hazardous waste facility that treats, stores or disposes of wastes in a solid phase, such as "dried" chemicals, explosives, sludges, etc. Typically, these releases would result from improper handling or breakage of containers used in the transport of these waste types within facility boundaries. Additionally, wind erosion is a mode of solid release.

Non-routine Gas Emission

This class of events includes non-routine emissions from incinerators, reaction products from the improper mixing of reactive wastes, failure of gas storage vessels and other accidental gas releases. Non-routine gas emissions can occur in both the surface and subsurface environments depending on the facility type.

Fire

Fires can best be classified along the guidelines established by the National Fire Protection Association Standard Number 10, described in Appendix 4.

Explosion

Explosions can occur in both the surface and subsurface environments according to facility type.

Dike Failure

While the class of events described by the term dike failure could be included in the category of non-routine liquid releases, dike failures represent a common and specific type of accident of potentially serious magnitude and, therefore, merit separate consideration. Dike failures can result from either natural causes, or from improper design and construction.

Direct Human and Animal Contact

These exposures can occur as the result of non-routine liquid and gas releases, and also in the course of routine operations. For example, a worker might accidentally step or fall into a disposal trench containing highly corrosive wastes. The potential for contact with hazardous wastes exists at every type of facility.

3. Hazardous Wastes

This section defines the hazardous waste category system developed for this study. The classification system has been devised so as to address comprehensive all conceivable waste types, i.e., it is capable of representing any type of existing or future hazardous waste stream. In addition, the classification presents the waste categories in a way which will relate meaningfully to contingency plan standards after incorporation with . facility/event pairings.

In general, existing waste classification schemes fall into one of four general categories:

1) classification of wastes by source
2) classification of wastes by disposal method
3) classification of wastes by chemical properties
4) classification of wastes by associated hazard.

For the purposes of developing standards for contingency plans, the following waste classification scheme was adopted. A complete discussion of the logic and rationale behind the development of the hazardous waste categories is presented in Appendix 5.

Flammable/Explosive Vapor

This category is reserved for gases and vapors which are flammable and/or explosive. In addition, it is applicable to liquids (or solids) which are extremely volatile and give off flammable/explosive vapors.

Flammable Solids/Liquids

This category is reserved for liquids, solids, sludges, slurries, etc. which are flammable.

Explosive Solids/Liquids

This category is reserved for solids, liquids, sludges, slurries, encapsulated or contained gases, liquids, etc. which may present an explosion hazard.

Bioconcentratives

This category is reserved for substances which may concentrate in a single species or through a series of species (plant or animal) in the human food chain to a level, above the ambient level, which are toxic or injurious to humans.

Corrosives

This category is reserved for substances which are corrosive to equipment, structure, containers, etc. which are likely to be found in hazardous waste facilities or which may be used at such facilities during emergencies.

Reactives

This category is reserved for substances which tend to react spontaneously in a hazardous way with common materials. Included in this category are substances which may undergo synergistic interactions. In this definition the term "hazardous way" means that the substance may react so as to produce any of the following effects:

a. violent reaction (spewing reactants)
b. rapid heat generation
c. generation of hazardous products

The term "common material" would include:

a. air
b. water
c. structural metals
d. other construction materials

Radiological

This category is reserved for materials which spontaneously emit ionizing radiation to the environment. This includes radionuclides and materials contaminated with radionuclides. It does not include materials covered by NRC regulations.

Environmental Hazard

This category is reserved for substances which pose a threat to the environment. This would not include the hazards of fire, explosion or radiological materials, nor would substances producing adverse effects on humans alone can be classified as environmental hazards. The emphasis of this definitional category is on materials with special effects on plants, crops, fish, shellfish, livestock, etc. and on those at higher levels in the food chain.

In addition, materials which might effect the structure, function, etc., of non-living objects in such a way that it may cause harm to plants, animals, or humans would be classified as an environmental hazard.

Airborne Health Hazard

This category is reserved for substances which may be transported via the air and which pose a health hazard to humans. This health hazard would not include the normal hazards associated with fires, explosion or radioactive materials. Hazards which would be included are:

a. inhalation toxic
b. dermal penetration toxic
c. irritating
d. sensitizing
e. etiologic
f. carcinogenic
g. mutagenic, teratogenic, etc.
h. ingestion toxic (applies to materials which might settle on the surface of plants which are subsequently eaten).

Waterborne Health Hazard

This category is reserved for substances which may be transported via water, in solution, suspension, or by flotation, and which pose a health hazard to humans. This health hazard would not include the normal hazards associated with fires, explosions or radiological materials. Hazards which would be included are:

a. ingestion toxic
b. dermal penetration toxic
c. irritating
d. sensitizing
e. etiologic
f. carcinogenic
g. mutagenic, teratogenic, etc.

Contact Health Hazard

This category is reserved for substances which may be transported via direct contact and which pose a hazard to human health. The direct contact might be via fallout from an explosion, splash from or contact with a spill, or mishandling of materials. The normal hazardous effect associated with fires, explosions, or radiological materials are not considered under this category. Hazards which would be included are:

a. dermal penetration toxic
b. irritating
c. sensitizing
d. etiologic
e. carcinogenic
f. mutagenic, teratogenic, etc.

Unknown

This category is reserved for materials whose compositions or properties are unknown. An example of an UNKNOWN hazard would be an unlabeled (perhaps due to corrosion or negligence on the part of an operator) drum of material which is in close proximity to a fire at a hazardous waste disposal facility.

As previously mentioned, at the time of this study EPA had not promulgated regulations defining what its hazard categories will be or what degree of danger will be necessary before a substance would be defined as "hazardous." Until threshold values are specified by regulation, it will be necessary to define waste categories in qualitative terms only.

4. Integration of Facilities and Events

In carrying out this study, a matrix (Integrate I shown in Figure 4) was used to correlate all possible facility types with all conceivable events to assess the applicability or non-applicability ("NA") of each facility/event pairing. All pairings considered possible were

Figure 4
INTEGRATE I
FACILITIES AND EVENTS

EVENT	NON-ROUTINE LIQUID RELEASE					NON-ROUTINE SOLID RELEASE		NON-ROUTINE GAS EMISSION		FIRE (N.F.P.A. STANDARD-10)				EXPLOSION		DIKE FAILURE	DIRECT CONTACT	
FACILITY / SUB-EVENT (TYPE OR MAGNITUDE)	SURFACE SEEPAGE	SUBSURFACE LEAKAGE	SURFACE FAILURE	SUBSURFACE FAILURE	PERSONNEL ERROR	WIND EROSION	PERSONNEL ERROR	SURFACE	SUBSURFACE	CLASS A	CLASS B	CLASS C	CLASS D	SURFACE	SUBSURFACE	SURFACE	HUMAN	ANIMAL
SECURE LANDFILL									NA						NA			
APPROVED LANDFILL									NA						NA			
INCINERATOR Liquid	NA	NA		NA		NA			NA						NA	NA		NA
Solid	NA	NA		NA		NA			NA						NA	NA		NA
Gas	NA	NA		NA		NA			NA						NA	NA		NA
WASTE LAGOONS/PONDS						NA	NA		NA						NA			
LAND BURIAL AT DEPTH	NA		NA			NA	NA			NA	NA	NA	NA			NA		NA
LAND BURIAL NEAR SURFACE	NA		NA													NA		NA
ABOVE SURFACE STORAGE				NA					NA						NA	NA		
FINAL TREATMENT PROCESSES		NA		NA		NA	NA		NA						NA	NA		NA

NA = non applicable

examined in the subsequent analysis. Furthermore, by inspection, certain subcategories of events and facilities (e.g., classes of fires) were grouped and have been represented below as general categories.

Examples of the approach used in forming general categories and in eliminating from consideration the non-applicable pairings are discussed below:

Non-routine Liquid and Solid Releases

Surface failures and seepages onto the surface of liquid hazardous wastes are by definition unlikely in underground hazardous waste facilities (i.e., land burial facilities) and are indicated accordingly as being non-applicable. However, some surface facility types such as lagoons and landfills, etc., can experience liquid releases induced by either structural failures or natural geohydrologic conditions which might affect both the surface and subsurface environment. Similarly, both environments could be affected by leaks or breaks in tanks, vaults or pipe lines used in final treatment processes and in above-surface storage facilities.

Also, Integrate I shows similar conclusions in the subcategories of landfills and incinerators listed regardless of the event type. These two groups are further considered in Integrate II (Figure 4), which will correlate specific event/facility types with hazardous waste types.

Non-routine Gas Emissions

Non-routine gaseous emissions can occur both above ground and in the subsurface environment depending on the facility type utilized for the disposal of hazardous wastes. Generally, hazardous wastes in a gaseous form are treated, stored or disposed of at a facility as a primary hazardous waste (i.e., chlorine gas, etc.) or are created as a secondary product of a particular facility treatment process or chemical reaction. A non-routine gaseous emission from hazardous wastes buried at depth or in a near-surface land burial facility is considered highly unlikely because of the types of hazardous wastes that are usually stored or disposed of in these facilities (i.e., liquid and solid wastes). Gaseous emissions normally occur at or above land surface. All facility types have the capability of releasing hazardous wastes in the gaseous state, depending on the hazardous waste type being processed.

Fire

Fire would appear to be one of the most common events likely to occur at hazardous waste facilities. Figure 3 indicates that the applicability of the N.F.P.A. classes of fires is similar for each facility type, suggesting the grouping of all fires under a single event category would be adequate for future comparisons.

Explosion

In general, serious consequences due to explosions will apply to surface facilities, threatening the lives of employees and creating fires which could spread to other areas in the vicinity of the explosion. In addition, the possibility of subsurface explosion exists in the inadvertent mixture of reactive hazardous wastes in man-made subsurface storage structures such as silos, tanks and vaults and in natural cavities in geological formations. The proper design of facilities and hazardous waste identification should greatly reduce the possibility for this type of accident.

Dike Failure

The most commonplace events cited and documented for particular facilities, whether due to natural disasters, improper design or human error, include dike failure, surface seepage and subsurface leakage, usually resulting in non-routine releases of liquids to the surface or subsurface environment. Figure 4 indicates that these particular events are directly related to certain facility types. For example, the possibility of dike failure exists at a hazardous waste landfill. A dike failure is not applicable at all facilities listed, but would commonly be associated with landfills, lagoons and ponds. However, in certain cases, similar backup systems (i.e., dikes or berms) are employed at other facility types. The release of hazardous liquid wastes after a dike failure is defined as a "non-routine release." A dike failure not associated with a release would be repaired in accordance with operational procedures. Only when the dike failure is associated with a release event would control and repair of the dike be covered by contingency plan standards.

Direct Human and Animal Contact

The matrix in Figure 4 indicates that direct contact by wildlife or humans is conceivable in nearly all cases. Obviously, mechanized hazardous waste disposal operations (i.e., deep burial) or enclosed facilities would limit the possibilities of direct contact by wildlife or humans. Access to certain types of facilities such as incinerators, and deep burial sites could also be minimized by proper design specifications. However, facilities such as lagoons, ponds and landfills could be vulnerable to intrusion from contiguous populated areas. Wildlife, especially from adjacent wilderness areas, would often have access and therefore a risk of exposure to these areas.

Causes of Events

Some causes of the aforementioned events are notable. For instance, any major natural disaster, such as an earthquake, tornado, hurricane or flood, will always have some type of adverse effect(s) on those facilities which operate at land surface (i.e., incinerators, landfills, etc.). Any natural disaster could conceivably damage a facility, resulting in the release of hazardous wastes. Actions taken in response to warnings of natural disasters are covered by operational plan standards. Releases resulting from natural disasters would fall into one or more of the categories described above and responses to such releases would be dealt with under contingency plans.

5. Integration of Hazardous Wastes with Facilities/Events

All applicable facility/event pairings were correlated with the various hazardous waste types to assess the applicability or non-applicability of each facility/event/waste grouping (Figure 5). As in the case of the integration of facilities and events, groupings became evident. This, together with the non-applicability of some pairings, reduced the number of possible facility/event/waste combinations. The contingency plan standards were developed using this integration.

Examples of the approach used in the elimination and grouping of the combinations follow.

Events Applicable to All Facilities

First, those events which are independent of the facility type were considered and related to all hazardous waste types; special cases where events and facilities are dependent on one another were then examined.

Figure 5 shows some general trends in comparing facility/event types with hazardous waste types. It is conceivable that any of the hazardous waste types, with the exception of those classified as flammable/explosive vapors and airborne health hazards,could reach the environment in the form of non-routine liquid or solid surface release. Similarly, there is no apparent correlation between waterborne health hazards, liquid or solid explosives or liquid or solid flammable wastes with an event such as non-routine gas generation at the surface. All other waste types, however, could conceivably be related to or occur in the form of a non-routine gas generation (i.e., corrosives, reactives,

Figure 5

INTEGRATE II

FACILITIES, EVENTS AND HAZARDOUS WASTE TYPES

FACILITY/EVENT		FLAMMABLE/EXPLOSIVE VAPOR	FLAMMABLE (LIQUID/SOLID)	EXPLOSIVE (LIQUID/SOLID)	BIOCONCENTRATIVES	CORROSIVES	REACTIVES (W/COMMON MATERIALS)	RADIOLOGICAL	ENVIRONMENTAL HAZARD (TOXIC, PERSISTENT, ETC.)	AIRBORNE HEALTH HAZARD	WATERBORNE HEALTH HAZARD	CONTACT HAZARD	UNKNOWN (UNLABLED OR IMPROPERLY IDENTIFIED)
ALL FACILITIES	NON-ROUTINE SURFACE RELEASE (SOLID)	NA								NA			
	NON ROUTINE SURFACE RELEASE (LIQUID)	NA								NA			
	FIRE												
	EXPLOSION												
	DIRECT HUMAN CONTACT												
	NON-ROUTINE GAS GENERATION (SURFACE)		NA	NA							NA		
LANDFILLS, LAGOONS, NEAR SURFACE BURIAL AND BURIAL AT DEPTH	NON ROUTINE SUBSURFACE RELEASE (LIQUID)	NA										NA	
	EQUIPMENT MALFUNCTION												
INCINERATORS	EQUIPMENT MALFUNCTION										NA		
FINAL TREATMENT PROCESSES	EQUIPMENT MALFUNCTION							NA					

contact hazards, etc.). If a non-routine gas generation did occur at a facility, it would be characterized by one of the other hazardous waste types listed.

Figure 5 indicates that there are inherent differences between the events of fire and explosion even though these events often occur concurrently at hazardous waste facilities. In the event of an explosion, corrective measures would obviously have to be taken regardless of the facility or hazardous waste type. Any of the various types of wastes could enter the atmosphere, surface and/or subsurface water environments depending on the severity or magnitude of the explosion. On the other hand, in the event of a fire, the applicability of hazardous wastes such as bioconcentratives, corrosives, reactives, radiological and waterborne health hazards is not directly apparent. Normally, these types of wastes would not enter the environment as gaseous emissions which would be released during a fire. However, the remaining hazardous wastes (i.e., flammable vapor, contact hazard,etc.) could very likely reach the environment if a fire were to occur.

Direct human contact with hazardous wastes at any facility is always applicable (see Figure 5) regardless of the hazardous waste type. Existing definitions of the term "hazardous waste" imply that precautions and measures must be taken to minimize the possibility of direct human contact with any hazardous waste. Also, responses would vary greatly in the event of direct human contact, depending on the hazardous waste type contacted.

Events Dependent on Facility Type

Deep-Well Injection

At certain facilities, events could occur in ways directly related to the facility type. One of these events, not addressed in the previous sections, is non-routine subsurface liquid release. In the specific case of a deep injection well, the non-applicability of introducing hazardous wastes in the vapor state is apparent. Another event type that could occur at a deep well injection facility is an equipment malfunction. For the most part, the applicability of equipment malfunction is related to all hazardous wastes, excluding flammable/explosive vapors, and airborne health hazards, whose inapplicability was discussed above. It is conceivable that a contact hazard, as defined, could have adverse effects if an equipment malfunction occurred at or near land surface. Furthermore, any equipment malfunction including a well blowout, casing failure, pressure loss or pipe failure, could result in a non-routine surface liquid release. Therefore, appropriate corrective actions should be included in that event category. These actions will be discussed in later sections.

Landfills, Lagoons, Near-Surface Burial and Burial at Depth

Figure 5 indicates that the non-applicability relationships between waste types and non-routine subsurface liquid releases at other hazardous waste facilities, including landfills, lagoons, near-surface burial and burial at depth, is similar to that discussed above for a deep injection well facility. An exception, however, might be radiological wastes; pertinent literature indicate that it is a common practice to store or dispose of radioactive wastes at burial facilities located near the surface and at depth. Also, it is conceivable that in the event of a non-routine subsurface liquid release, airborne gaseous emissions could be created indirectly because of a change of state in the waste as it reached the land surface. Because it would be very difficult to detect a subsurface gaseous emission before it migrated to the surface, examination of remedial actions will focus on the primary event, a non-routine subsurface liquid release.

Equipment malfunctions are a common occurrence at landfills, lagoons, ponds and burial sites and must be addressed. Figure 5 indicates that an equipment malfunction at that facility type is applicable to all hazardous waste types. A wide variety of equipment is utilized depending on the facility types. More importantly, these facilities are used to treat, store and dispose of a wide variety of hazardous waste types. Many types of hazardous wastes may be present in a particular landfill facility. For this reason, an equipment malfunction at any of these facilities theoretically could cause the release of virtually any hazardous waste type to the environment and specific measures would have to be undertaken to mitigate potential adverse effects depending on the hazardous waste type.

Incinerators

Some hazardous waste facilities, especially incinerators and other process-intensive final waste treatment techniques, rely extensively on equipment, mechanical or electrical, to store, transmit or process the wastes. Because of the numerous operations and functions at these hazardous waste facilities, the occurrence of an equipment malfunction is more probable as compared to facilities such as landfills and lagoons.

Several types of incinerators are used to dispose of hazardous wastes in a liquid, solid or gaseous form. The equipment needed to handle these wastes will vary. Presently, incineration is a major technique used for hazardous waste disposal. Theoreticially, most hazardous waste types can be reduced in volume or disposed of by this method; however, in practice, high costs of fuel, power and air quality standards prevent the use of incinerators for many wastes. Most hazardous waste types are disposed of in a more cost-effective manner at other types of facilities.

Figure 5 shows that almost all of the hazardous waste types could be released to the environment in the event of an equipment malfunction.

Final Treatment Process

Some industries that generate hazardous wastes dispose of or contract out for disposal by means of various final treatment processes. These processes effectively degrade, alter, destroy, or completely recover hazardous wastes. Detoxification, detonation and chlorination are a few examples of final treatment processes that effectively eliminate some wastes so that they will not detrimentally affect the environment. Usually, chemical industries incorporate final treatment processes directly into the production system to treat hazardous wastes, thereby reducing the wastes to innocuous by-products which can be disposed of by conventional methods (i.e., sanitary landfill, etc.).

Figure 5 indicates that all hazardous waste types with the exception of radiological wastes, can be treated at least partially by some final treatment process. The complicated mechanical and electrical systems and equipment used to convey, alter and finally produce chemical substances increase the opportunity or probability of an equipment malfunction. Because of the large variety of equipment, plant location and possible paths to the environment, each final treatment process and hazardous waste type must be evaluated separately to determine appropriate measures that must be taken to correct a possible release of the waste to the environment.

The analysis of the facilities, accident events, and hazardous wastes that characterize the hazardous waste industry is reported here in considerable detail to demonstrate the wide variation on a site-by-site basis that can be expected in the contingency plan needs of the industry. In recognition of this, contingency plan standards were put forward that are basically applicable to all sites, while flexible enough to permit major site variations to be incorporated into the implementation of the standards at each site. Contingency plan standards are discussed in the following section.

C. Contingency Plan Standards

Introduction

The material in Sections A and B describes the reasoning used to develop the facility/event/waste matrix. This matrix is displayed in Figure 5. Once the applicability or nonapplicability of each facility/event/waste intersection was determined, contingency plan standards were developed which could be applied to one or more of the applicable matrix intersections.

Several approaches were used to develop the contingency plan standards. First, a thorough literature search of federal agency guidelines and industrial guidelines in the private sector was undertaken. Only the Nuclear Regulatory Commission (NRC) guidelines presented detailed contingency plan standards. Other general standards were identified. In this manner independent sources of standards were used to adopt contingency plan standards where applicable. These standards were helpful in developing organizational and communication standards, as well as some assessment standards.

Secondly, random groupings of potential contingency plan standards were found in literature for certain industries which more or less applied to specific accidents (events) such as fires, oil spills and releases of noxious gas. Wherever an association between these varied standards and the matrix could be seen, specific standards were incorporated or modified to fit the given situation. For example, it is very likely that a standard regarding actions in case of fire at an industrial plant may apply in the event of a fire created by release of a specific hazardous waste at a particular facility. Standards of this type found through the literature search were very helpful in determining assessment and response/recovery standards.

The third approach used in developing contingency plan standards was directly dependent on and related to specific matrix intersections. Individual intersections or similar groups of intersections were chosen that might be associated with certain general contingency plan standards.

Separately a listing of general contingency plan standards was developed which encompassed several of the more obvious events and hazardous waste types. For example, when dealing with flammable or explosive wastes certain standards would apply regardless of the facility type. In addition, the more unusual types of events or hazardous waste types found at certain facilities were addressed on an individual basis. The standards in these cases were written keeping in mind a specific intersection being evaluated. For example, the accidental release of bioconcentratives while buried at depth might necessitate separate contingency actions which do not apply to any surface releases. These specific standards were generally associated with the assessment and response/recovery standards.

Finally, the three approaches were combined, thereby producing a comprehensive set of standards that could be used in any facility/event/waste situation. Furthermore, subsets of standards could be derived from these contingency plan standards that could apply to any specific intersection.

Assumptions Made in Writing Contingency Plan Standards

In devising standards for contingency plans, certain assumptions have been made based primarily upon discussions with EPA project monitoring staff. It is assumed that contingency plans go into effect when the release of hazardous materials has occurred, may be imminent, or is suspected to have occurred. Presumptive evidence that one or more of these conditions are present include: fires in the vicinity of hazardous waste containers; explosive gas conditions which could disperse hazardous particles, gases, or aerosols if denotation should occur; and, any employee illness or incapacitation displaying toxicological characteristics.

It is further assumed that operating standards, which are presently being developed by EPA, will require certain items to be on-site, or actions to be taken, which would provide the basis for some of the contingency plan standards that follow. For instance, protective clothing, evaluation of environmental baseline conditions, communications equipment, to name a few, are expected to be required under operational standards.

Contingency actions, then, go one or more steps beyond those required under operating standards. The costs of contingency plans have been calculated accordingly.

Precautionary measures to be taken in the event of warnings of natural hazards are expected to be covered by operational standards. Thus, it is assumed that responses to hurricane, tornado or flood alerts, such as protective shut-down of the facility, would be applied under operating rules established for the facility. Actions relating to any releases caused by these natural events would be covered by the contingency plan standards.

Divisions of Contingency Plan Standards

The standards are written in four main groups. The first two groups (Organization and Communication) essentially involve actions that must precede any emergency. The remaining groups (Assessment and Response/Recovery) would be put into effect at the time of the emergency.

Response Times and Distances

In a number of the standards that follow, numerical values are used to define distances and periods of time in which certain requirements must be met or response action undertaken. The numerical values assigned reflect the generalized distance or time periods judged responsible, prudent and safe with respect to a particular standard.

ORGANIZATIONAL STANDARDS

Organizational standards are aimed at insuring a well-defined, effective and coordinated emergency effort, and deal primarily with authority and responsibility in maintaining, implementing and activating a contingency plan.

1. Standard for Requiring an Approved Contingency Plan:

Every operator of a facility engeged in, or permitted to engage in, treatment or storage for a period of more than 90 days, or disposal of any materials defined as hazardous wastes under the provisions of the Act shall be required to formulate a contingency plan to minimize unanticipated damage in the event of discharge of aforesaid hazardous materials to the surrounding air, surface and subsurface environment. This plan must be submitted to and approved by the permitting agency.

2. Filing the Contingency Plan:

The contingency plan must be filed with the responsible permitting authority and EPA and all local public and private entities which may be called upon to provide services in the event of emergency. All revisions to the plan must be promptly reported, in writing, to all parties in possession of copies of the contingency plan.

Note: The requirement that the contingency plan be filed with EPA could be modified to require the plan to be submitted to the state administrator of solid waste planning. However, until the roles of federal and state agencies in regulating hazardous waste management facilities is resolved the appropriate agency cannot be determined.

3. Defining Civil Authority:

The contingency plan must define the extent of interaction between facility personnel and local public and private organizations in the event an accidental release threatens the general public and/or the local environment.

Note: The authority of an operator of a waste facility to make emergency declarations would end at his property boundary. Beyond that boundary, he has a responsibility to communicate emergency declarations to civil authority. No part of the Act changes the authority or responsibility of local civil authorities to act initially within this basic charter - the protection and preservation of life and property. The lines of authority include police (control of persons and securing of areas), fire, and medical authorities. Because emergency situations are related to dispersion of hazardous materials, multiple geographic jurisdictions of each type of authority may be involved. Furthermore, authorities in some areas may be limited in the responsibilities delegated to them, or which they are willing to accept: fire departments would be expected to deal with smokes, gases, and flammable materials, but some fire departments also provide all first-aid and ambulance medical services. Some localities provide for coordinated emergency functions; others do not.

4. Defining Internal Authority:

The contingency plan must include the names of the persons given primary responsibility for coordinating emergency response measures at all times. The names of alternate emergency response coordinators must also be listed.

Note: For contingency purposes, it is assumed that a responsible owner/operator is defined for each hazardous waste facility, and an operator, directly responsible as the agent of the owner, is on the site at all times during the operating life of the facility, unless a variance is granted by EPA.

5. Response to Emergency Inquiry:

Every operator of a hazardous waste facility shall be capable of providing information at all times in the event of emergency inquiry. The name and phone number of a person qualified and authorized to act as responsible agent shall be maintained on file with all local authorities, to include, but not be limited to:

a. the nearest police agency with round the clock personnal and preferably with the policy agency of every jurisdiction within three miles of the facility

b. the nearest fire agency with round the clock personnel and preferably with the fire gaency of every jurisdiction within three miles of the facility

c. the medical doctor, clinic or hospital named by the operator as providing services to employees of the facility.

The responsible agent shall be thoroughly familiar with the substances handled at the facility, the location of the manifests within the facility, and the locations and characteristics of the different wastes stored on-site.

6. Facility Contingency Equipment Standards:

The contingency plan will list and describe all equipment to be utilized in emergency situations for worker safety, emergency communications, alarms, and spill recovery (equipment, chemicals, foam, water, etc.).

7. Information on Exposure Symptoms and Treatment:

The operator will maintain information regarding the symptoms and required treatment for exposure to all hazardous materials handled at the facility, as well as their expectable by-products. Such information will be provided to appropriate medical agencies in the event of employee exposure, or a large scale release.

8. Inactive Sites:

Any administrator (person), upon nomination as the custodian of an inactive waste disposal facility shall, before assuming those duties formulate a contingency plan to minimize unanticipated damage in the event of discharge of hazardous waste materials to the surrounding air, surface, or subsurface environment.

Note: After the capacity of a landfill/burial site has been exhausted, the site will become inactive. Attendant receiving, treatment, handling, etc., will cease (although treatment of hazardous materials unrelated to disposal at the site might not be precluded). Under Section 3004 (6), which outlines requirements for maintenance of operation of the facility, it is assumed that a custodian, either a private or public entity, will maintain surveillance and control of the site for a period determined pertinent by regulatory agencies and consistent with the nature of the hazardous materials disposed.

9. Training and Drills:

The contingency plan shall include specification of operator training requirements and the type, number, and frequency of drills required to maintain a state of awareness and preparedness.

COMMUNICATION STANDARDS

Communication standards are intended to insure positive and pre-planned notification to emergency authorities in the event of accidents or hazardous discharges. In preparing the standards, it has been considered that: all fires, including short-lived ignition of unexplained free gases; any detonation except one controlled entirely within the operating limits of an incinerator chamber; any situation requiring employee evacuation; any employee injury due to spontaneous rupture of a container; or any release of hazardous gases, fumes, or dusts, outside the regulated area of the facility may require automatic alert to a detached fire department. With a direct fire alarm signal available, it has been estimated that ordinary telephone service should be adequate for emergency communications for ambulance service, requests for police assistance, etc.

1. Pre-Contingency Notification of Nature of Hazards:

The operator of any hazardous waste management facility engaged in treatment storage, or disposal of materials specified under this Act shall communicate the following to all local agencies which may provide emergency services to the facility:

a. the nature of the materials
b. maximum amounts received during an operating cycle
c. known deleterious effects of the material(s)
d. modes by which this material might be released to the environment
e. areas which could reasonably be expected to suffer exposure during any accidental release.

2. Emergency Communication Equipment:

Any facility engaged in the treatment, storage, or disposal of hazardous waste materials specified under the Act shall be equipped at a minimum with:

a. regular single-party telephone service
b. an alarm system capable of summoning emergency assistance external to the facility, and/or simultaneously notifying civil authorities responsible for emergency services
c. an internal communications system capable of providing immediate instruction to all employees.

Note: Two way radios should be considered at least for waste facilities because there may be some damage to telephone wires due to fire or explosion.

3. Internal Alarms:

The operator should insure that when hazardous wastes are being poured, mixed, spread or otherwise handled, at least one employee involved in the operation has immediate access to an alarm device, which can be activated by a single motion, capable of summoning aid or warning of unsafe or unknown conditions. The employee with immediate access to the alarm should be in clear visual and aural contact with all other employees involved in the operation who do not themselves have access to alarms or who are not in contact with another employee who has access to an alarm. If at any time during operation of the facility, there shall be a sole employee on the premises, the alarm should be capable of directly summoning aid and providing emergency warning to an emergency response authority external to the facility.

4. Notification of Required Agencies:

A contingency plan shall list the EPA office and other agencies and local authorities responsible for environmental quality or public health and safety to be notified in the event of an accidental release at the facility. The plan shall list such agencies separately for each of these major classifications;

a. suspected hazardous airborne release;
b. confirmed hazardous airborne release;
c. surface liquid release escaping the facility confinement;
d. detection of materials in leachate exceeding the established acceptable limits for the facility;
e. structural damage to the facility caused by any accidental event;
f. discharge of hazardous materials into navigable water as defined by Public Law 92-500.

ASSESSMENT STANDARDS

Assessment standards are aimed at 1) providing prompt appraisal of the extent and severity of dispersion and contamination from the accidental release of hazardous wastes to the environment, and 2) assisting in selecting an appropriate response to mitigate potential adverse effects from the release of any contaminants.

Assessment standards are distinguished here from response standards in that the former are aimed primarily at providing immediate guidance on the nature, concentration, volume, extent of dispersion, and areas threatened or affected by contaminants. Often the area affected must be delineated by a physical or mathematical model.

1. Airborne Dispersion Model:

The operator of any facility that may be deemed capable of generating an airborne contaminant shall prepare an atmospheric dispersion model for the site, using meteorological records, and maintain at all times current data on ambient meteorological conditions. The results must be detailed enough to provide precise (acceptable) plume boundary and concentration information. The model should consider variables including: meteorological conditions, temperature of the airborne release, density of the released material, diffusivity of the released material, concentration of the released material, duration of the release, elapsed time since release ended, features of the local terrain, and teh degree of hazard associated with the material. In addition, the following requirement must also be met:

a. the model should be capable of completing its output within a reasonable period of time depending on the type of facility, hazard, etc.

b. the model must be approved by the EPA, or other governing authority under a state implementation plan;

c. airborne hazard maps (or overlays showing anticipated affected areas) must be prepared in advance and be accessible for use within 5 minutes (X minutes) by a trained person.

d. the maps or overlays shall be prepared using an appropriate model (see, for example, those detailed in the Nuclear Regulatory Commission (NRC) regulatory guide):

e. a copy of the maps or overlays shall be on file with local emergency authorities within the radius of possible effect,

2. Waterborne Dispersion Model:

The facility operator shall determine, where practicable, the concentrations, directions and rates of movement of the hazardous waste by use of site-specific hydrologic and water quality models designed to predict the area, in either the surface or subsurface environments, affected by the release. The models should be approved by EPA or other governing authorities, and should consider such factors as runoff rates, local topography, permeability, porosity, infiltration rates, local ground water velocities, chemical characteristics, viscosity and density of wastes, and the background chemical characteristics of water environments affected.

3. Identification of Material:

The facility operator shall identify to these public and private bodies which may provide emergency services to the facility the character and concentration of the spilled or released material. This could be accomplished by review of facility manifests and/or chemical analysis.

4. Source and Extent of Release:

The facility operator shall determine, where possible, or estimate the exact source, volume and extent of the spill or release and report this to the predetermined public and private agencies who will be providing emergency services to the facility. This shall be done in a timely manner.

5. Atmospheric Release Assessment:

In the event of a gas leakage, fire, explosion or liquid release, which produces or releases gases, vapors, dusts, or mists, an operator should be prepared to predict the dispersion patterns of a hazardous material which is released into the atmosphere by applying pertinent meteorological data to the approved model; and the degree of hazard associated with the dispersing material.

6. Waterborne Release Assessment:

The facility operator should apply all pertinent geohydrologic, water quality and climatological data, including the most recent data obtained from monitoring systems, to the available site-specific model, as noted above, to assess the potential effects of releases of contaminants to the surface and subsurface environments. Where practical, the model should be used in advance to prepare approximating maps (or overlays) which may be quickly accessible during an emergency.

7. Fire Assessment:

An operator must be prepared to assess the degree of hazard associated with a fire or threatened fire at a facility and determine the actions which should be taken to mitigate damage or injury. The determination should indicate whether:

a. evacuation should be initiated because of certain imminent dangers such as toxic combustion products, flammable or explosive vapors, threatened explosion caused by fire, etc.; or

b. members of the local community may be exposed to hazardous substance.

The assessment of the degree of hazard should consider indirect effects such as toxic, irritating, or asphyxiating combustion products; hazardous surface runoff due to water or other chemical agents used to control fire; and heat induced explosions. Obviously any actual evacuation notice and/or the actual task of evacuation will have to be initiated and executed by the proper local authorities.

RESPONSE AND RECOVERY STANDARDS

Response to an emergency situation must follow immediately after assessment. The line between response and assessment is of its nature indistinct, but for organizational purposes it will be assumed that once the assessment phase indicates the magnitude of the event (e.g. concentration of contaminant, area affected etc.) all following actions are a response to it. The response phase culminates in recovery from the effects of the event.

The contingency standards for response to emergencies apply whether air, water or the ground surface is contaminated. They, furthermore, apply to all the facilities, events, and waste types as described in other sections of this report. Consequently, response and recovery standards will be addressed under the following subcategories: notification;

shut-down of facility; evacuation; delineation of affected area (including monitoring and modeling); collection and/or containment of released wastes; the continuing assessment of affected areas; personnel availability; medical treatment; alternate water supply; and fire fighting and prevention.

Notification of Release

1. The facility operator shall activiate on-site alarm systems to notify all personnel that a release is imminent or has occurred.
2. The facility operator shall notify appropriate agencies with designated response roles immediately if said release threatens contiguous populated areas or the local environment.
3. The facility operator shall record the time, date, quantity and nature of the release, and convey a preliminary report with this and any other pertinent information on the incident to the appropriate regional office of the EPA within 24 hours.
4. The facility operator shall, at a later time not to exceed 15 days, submit a final report of the incident to the EPA including information regarding damage, personal injury, corrective actions taken and plans for preventing recurrence.

Shut-Down

5. The facility operator shall provide adequate switching mechanisms for cessation of processes; and for the shielding or containment of unprocessed hazardous materials.
6. The facility operator shall designate those personnel who will control any shut-down procedures and shall insure that said personnel are available within a specified period of time after a release.
7. The facility operator shall monitor for the possibility of releases subsequent to shutdown including leaks, pressure buildup, gas generation or ruptures in valves, pipes or other devices or equipment.

Evacuation

8. The facility operator shall notify the appropriate responsible agencies as soon as his assessment has indicated that public evaluation is necessary.
9. The facility operator shall begin evacuation of all personnel on the site immediately if the release poses an immediate threat to the health and safety of the personnel by virtue of either the amount, concentration or unusual characteristics (i.e. combustion, toxicity, etc.) of the release.
10. The facility operator shall assist, as advised by responsible agencies or parties, in any evacuation procedures deemed appropriate by those agencies.

Monitor and Delimit Affected Area

11. The facility operator shall secure against entry of unauthorized personnel those areas which are under his jurisdiction, (i.e., within the facility boundaries). He shall also notify appropriate agencies or parties regarding those areas which should be secured which are outside of his jurisdiction when such actions are necessary to prevent public exposure.
12. The facility operator shall continue the modeling and monitoring of air, surface or subsurface waters initiated in the assessment phase to determine the concentration, direction, rate of movement and extent of contamination.
13. The facility operator shall have all water and air samples analyzed for those chemical, physical and biological parameters deemed appropriate by the authorized regulatory agencies. The analysis will be by a laboratory approved by the responsible agency.

Collection and/or Containment of Waste

14. The facility operator shall secure the immediate area where a release has occurred with impermeable cover materials, dikes, channels or trenches so as to contain the wastes and preclude precipitation and runoff water from contacting the wastes.

15. The facility operator shall immediately initiate containment and/or collection of wastes where said material poses an imminent threat to human health and safety. Plans for cleanup shall be developed as part of the contingency plan.

16. The facility operator shall provide for placement of recovered wastes and contaminated soils in a designated emergency storage area. Furthermore, he must provide a means for ultimate treatment, storage or disposal of such materials.

17. The facility operator shall continue to assist in the collection and containment of any material which has escaped from the boundaries of his facility until such time as the affected area is declared safe by the EPA or other regulatory authority.

18. The facility operator shall avoid the receiving or handling of any wastes which may be reactive or incompatible with the released material or which may result in the possible generation of secondary contaminants such as dusts, mists, vapors or liquids until clean-up procedures are completed.

19. The facility operator shall clean up and restore all emergency equipment including vehicles, sumps, temporary storage containers, etc. to pre-release conditions in a timely manner.

20. The facility operator shall determine, or contract for the determination of, any failures or loss of integrity of containment equipment to insure that the structures, devices or barriers have not been damaged or altered and meet all permit requirements under Section 3004 (4) of the Act.

Continued Assessment of Affected Areas

21. The facility operator shall continue to monitor and assess any damage to the environment from the release of the contaminants until such time that the affected areas are restored and normal operations have resumed.

22. The facility operator shall file with the appropriate authorities monthly reports that record additional environmental, health and

other pertinent information until the affected areas are restored and normal operations have resumed.

Personnel Availability

23. The facility operator shall insure that sufficient qualified personnel are available on site, or have been notified and can reach the site within a specified period of time to initiate appropriate emergency response measures and/or assessment operations.

24. The facility operator shall insure that qualified personnel assigned to utilize appropriate models are available, or on call, and can begin to incorporate any new data, adjust programs and update parameters input in modeling the release.

Medical Assistance and Treatment

25. The facility operator shall provide that a physician and medical equipment including ambulances and emergency treatment be available from nearby hospitals or clinics for the emergency first aid of injured personnel that have been exposed to hazardous waste materials.

26. The facility operator shall provide emergency assistance, as directed by appropriate authorities, which will aid in treatment of any persons in contiguous population areas who have been exposed to or adversely affected by the release.

27. The facility operator shall furnish information to appropriate medical agencies regarding the symptoms and necessary treatments for exposure to all hazardous materials which are handled and any by-products of the materials.

28. The facility operator shall make available, or have access to, adequate decontamination equipment including showers, chemical agents and disinfectants, etc., to safeguard the health of all employed personnel.

29. The facility operator shall, in the event of fire, activate all necessary alarm systems including required on-site direct communication systems to local fire authorities.

30. The facility operator shall issue fire fighting equipment to designated emergency response personnel as a initial response measure to contain or reduce any local fire.

31. The facility operator shall, in the event of fire, ascertain the location of any explosive materials in the immediate vicinity and employ appropriate measures, including removing containers, cooling to reduce pressure buildup, or isolating containers either physically or with chemical substances, to minimize the risk of subsequent explosion.

D. STRATEGY ISSUES FOR THE IMPLEMENTATION OF CONTINGENCY PLAN STANDARDS

This section addresses the issues inherent in five different strategies in terms of the advantages and disadvantages of the regulatory options offered by each strategy, as well as the degree of human health and environmental protection afforded. Each strategy issue can be discussed in general terms of its effect on all standards.

STRATEGY ISSUE I - STANDARDS BY FACILITY TYPE VERSUS UNIFORM STANDARDS FOR ALL FACILITIES

With respect to facility type, two options are available for writing contingency plan standards. Either a single set of standards may be written which applied uniformly to all types of facilities, or separate sets of standards may be written for each major facility type. The appeal of separate sets of standards is based on the premise that the various facility types are clearly distinct in character. This premise is not entirely correct, however. While it is true that there are unique features which distinguish various facilities, it is also true that a great deal of commonality exists. Most facilities handle wastes with the same basic accident potentials. The primary differences between facilities are physical design and methods of operation. Design and operation are not within the scope of contingency standards. Though the specific response to an accident will vary according to the peculiarities of a site, facility specific standards will not take this into account unless they are coupled with site specific, case by case regulations. If site specific regulations were promulgated, the myriad of location and environmental conditions which might be encountered would make the standards unduly complex and lengthy. Because of the length and complexity, the cost of developing such standards would be much greater than uniform standards.

The motivation for uniform standards applied to all facilities is based on the opposite premise from facility-specific standards, i.e., it is based on the commonality of various facilities. The major advantages are lower cost for development, implementation, and uniformity of administration. Since there is much in common between facility types with respect to accident potential, uniform standards have the same options for being specific as facility-specific standards. The major disadvantage of uniform standards is that they could in some cases discriminate against certain waste handlers by setting requirements which may not be warranted because of physical circumstances, volume of waste handled, and the like. A system of waivers could be used to mitigate such cases.

STRATEGY ISSUE II - FEDERAL REGULATION VS. STATE REGULATION

Contingency plan requirements can be promulgated under three regulatory strategies: federal regulations only, state regulations only, or combined federal/state regulations. These three options will be discussed with the relative advantages and disadvantages inherent in each.

Federal contingency plan requirements would presumably take the form of guidelines issued by EPA for the preparation of contingency plans, including a number of mandatory requirements to be contained in such plans. The advantages of national standards include uniformity of administration and enforcement of regulations, elimination of certain states as "havens" for facilities because of their inadequate regulations, relieving states of the burden of regulating specialized, and often sophisticated, operations (particularly the states with only a small number of facilities), and elimination of the duplication of effort in the research behind preparation of the regulations. Furthermore, federal regulation could make it administratively more feasible for participation by a federal "response team" in assessment of, response and recovery from, hazardous waste releases. The concept of a response team in terms of assessment and cleanup has been successfully demonstrated on a regional basis. To a lesser degree, such teams have also been established in some states. Major disadvantages of this regulatory strategy include the costs and administrative burdens of federal monitoring and enforcement, and the negative incentive for innovative state programs for dealing with hazardous management programs.

Under a state-only regulatory strategy, the federal government would provide guidelines for state regulatory programs, and technical support to those states requesting it. The program suggested would then be modified in response to local needs or interest groups. The major advantages of this option include the ability of states to adopt regulatory schemes to review proposed contingency plans on a case-by-case basis, enabling consideration of local characteristics at each site (i.e., proximity of population centers, local fire fighting capabilities, hydrology, geology and climate of the area) and the low overall cost to the federal government. The major disadvantage is the burden placed on each state to acquire additional personnel having the necessary technical expertise to judge the adequacy of plans submitted.

The most attractive regulatory option with regard to federal vs. state regulation of contingency plan requirements may be the combination of federal and state controls contemplated by RCRA. The federal EPA, using the technical resources available to it, may publish guidelines for state regulatory programs. In addition, minimum contingency plan requirements would be promulgated as federal regulations. Authority to grant permits would be delegated to the states, enabling adequate consideration of site-specifics. This approach would eliminate most of the disadvantages and provide most of the advantages for the alternative listed above.

STRATEGY ISSUE III - EXACT AND SPECIFIC REQUIREMENTS VS. AD HOC FLEXIBLE REQUIREMENTS

The issue to be addressed here concerns the level of detail to be contained in the uniform contingency plan standards. The greatest degree of public safety and environmental protection would be provided with specific requirements. However, due to the wide variety in facility designs and sizes, site characteristics, and local emergency services available at each location, a very extensive and cumbersome administrative program would be involved. Additionally, considering the relatively brief experience of the hazardous waste management industry, many innovations in techniques of treatment, storage and disposal, as well as emergency response are expected. These developments would require constant revision of specific standards governing contingency plans.

Flexible, or ad hoc, requirements could state the objective of the standard without specifying the technique to be employed. These requirements enable the tailoring of contingency plans to individual facilities and encourage innovation. However, evaluation of the adequacy of contingency plans becomes quite difficult, requiring extensive review by qualified regulatory authorities.

On balance, the exact and specific requirements appear to be preferable because regulation would tend to be more uniform and objective.

STRATEGY ISSUE IV - ENFORCEMENT OF CONTINGENCY PLAN REQUIREMENTS BY SELF MONITORING OR PERMIT AGENCY INSPECTION

There are usually two regulatory strategies related to enforcement of contingency plan requirements. In both approaches, it is assumed that the contingency plan would be reviewed by the permit granting authority to determine if it adequately addressed the regulations in affect. Under the first strategy, the EPA and the permitting agency would rely on the permittee to monitor and provide information to them concerning the adequacy of the plan. The second approach would require periodic inspection of the facilities by EPA and/or the permitting agency to confirm that the measures described in the plan were in force.

The determination of the feasibility of inspection for contingency plan compliance is dependent on the decision whether or not to require an inspection program to determine compliance with design and operating standards. If such an inspection program is instituted, the additional annual costs associated with determining compliance with contingency plan standards would be minimal. If such a program for design and operating standards is not instituted the costs of instituting an inspection program solely for contingency plans would be very expensive.

Flexible, or ad hoc, requirements could state the objective of the standard without specifying the technique to be employed. These requirements enable the tailoring of contingency plans to individual facilities and encourage innovation. However, evaluation of the adequacy of contingency plans becomes quite difficult, requiring extensive review by qualified regulatory authorities.

On balance, the exact and specific requirements appear to be preferable because regulation would tend to be more uniform and objective.

STRATEGY ISSUE V - HANDLING VOLUME LIMITATION

By establishing limits on the handling capacity of individual facilities, the overall threat to human safety and the environment might be reduced for two reasons. By limiting the amount of hazardous wastes in temporary storage at a given facility, the magnitude of the maximum possible accidental release would be reduced; and handling limitations would force an increase in the number of facilities, possibly resulting in an overall reduction in transport of the wastes, and therefore the number of transportation-related accidental releases. A disadvantage of such action would be the increased risk of accidental releases resulting from the greater number of facilities. A policy of requiring small facilities would also increase the problem of finding enough suitable sites. Geological and hydrological constraints will limit the potential number of suitable sites. Popular opinion may be a factor also in that it may be more difficult, in terms of citizen resistance, to establish many small sites than a few large ones.

E. COMPATIBILITY OF CONTINGENCY PLAN STANDARDS WITH EXISTING FEDERAL LAWS AND REGULATIONS

INTRODUCTION

Section 1006 of the Resource Conservation and Recovery Act of 1976 requires that the provisions of the Act be integrated with the appropriate provisions of the Clean Air Act, the Federal Water Pollution Control Act, the Federal Insecticide, Fungicide and Rodenticide Act, the Safe Drinking Water Act, the Marine Protection Research and Sanctuaries Act of 1972 and other such acts which grant authority to the EPA administrator, to avoid duplication among the acts and enable their efficient administration and enforcement. The purpose of this section is to review the provisions of the above laws which deal with areas related to emergency response requirements or plans in order to establish the extent of existing laws with regard to contingency plan requirements.

CLEAN AIR ACT

Section 112 of the Clean Air Act authorizes the Administrator of EPA to set standards for hazardous air pollutants at any level "which in his judgment provide an ample margin of safety to protect the public health". Specifically, asbestos, beryllium and mercury are three hazardous pollutants for which emission limits have been promulgated. However, emergency response requirements for the accidental release of hazardous pollutants above these levels are not addressed in the act. Hazardous waste facilities which handle substances for which emission standards have been set under this act must meet these emission standards. However, any contingency plan standards promulgated under RCRA would be outside the scope of the Clean Air Act, and would thus be compatible.

THE FEDERAL WATER POLLUTION CONTROL ACT

In response to the President's request for the Council on Environmental Quality to carry out subsection (c) (2) of section 311 of the Federal Water Pollution Control Act, as amended, (33 U.S.C.1251,et seq.), the Council developed the National Oil and Hazardous Substances Pollution Contingency Plan. The objectives of the Plan are "to provide for efficient, coordinated and effective action to minimize damage from oil and hazardous substance discharges, including containment, dispersal and removal." The Plan is effective "for the navigable waters of the United States and adjoining shorelines and for the contiguous zone and the high seas where a threat to the United States waters, shoreface, or shelfbottom exists."

The most significant provision put forth under the Plan potentially related to hazardous waste management facilities is the requirement that any person in charge of an onshore facility shall, as soon as he has knowledge of any discharge of oil or a hazardous substance into navigable waters, immediately notify the nearest EPA or United States Coast Guard office of such discharge. In the event the responsible party is unable to eliminate the threat to the U. S. waters, shoreface, or shelfbottom,the federal government is assigned the task of undertaking response activities to minimize damages from such discharge. The federal government is then authorized to bring suit against the party responsible for the discharge for costs incurred in the response effort.

In summary, the National Oil and Hazardous Substances Pollution Contingency Plan imposes two requirements on hazardous waste facilities if an accidental release from such facilities threatens navigable waters: notification of EPA or the Coast Guard, and recovery of the release. Since both these requirements are included in the contingency plan standards discussed earlier, there would be no incompatibility between the contingency plan standards promulgated under RCRA and the National Oil and Hazardous Substances Pollution Contingency Plan. Moreover, most hazardous waste management facilities will probably be located far from navigable waters.

Through the Federal Water Pollution Control Act Amendments of 1972, the federal government was granted some authority over deep well injection, since the legislation requires state regulation of the disposal of pollutants in wells as a prerequisite for qualification for federal funding of area-wide waste-treatment management. Using this authority, the EPA Administrator, through the Administrator's Decision Statement No. 5, has recommended the requirement that contingency plans that will aid in preventing any environmental degradation must be prepared to cope with all well shut-ins or any well failures prior to issuance of permits by state authorities. Therefore, the only requirement issued under this authority for facilities employing deep well injection is that a contingency plan be prepared which concurs with the requirement which could be promulgated under RCRA.

THE FEDERAL INSECTICIDE, FUNGICIDE AND RODENTICIDE ACT

Under the authority of the Federal Insecticide, Fungicide and Rodenticide Act, as amended by the Federal Environmental Pesticide Control Act of 1972, the EPA promulgated "Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticide Containers" (40 C.F.R. 165). The following guidelines pertinent to accidents at hazardous waste management facilities were published:

1. "All accidents are incidents involving the storage or disposal of pesticides, pesticide containers or pesticide related wastes should be reported to the appropriate Regional Administrator."

2. "Containers should be checked regularly for corrosion and leaks. If such is found, the container should be transferred to a sound, suitable, larger container and properly labeled. Materials such as adsorptive clay, hydrated lime and sodium hypochlorite should be kept on hand for use as appropriate for the emergency treatment or detoxification of spills or leaks."

3. A number of accident prevention measures are suggested.

4. The use of protective clothing and respirators is recommended for all employees handling pesticides.

5. "Where large quantities of pesticides are stored, or where conditions may otherwise warrant, the owner of stored pesticides should inform the local fire department, hospitals, public health officials and police department in writing of the hazards that such pesticides may present in the event of a fire."

In all likelihood, most pesticides related wastes will fall into the category of "hazardous wastes" in the classification to be promulgated under RCRA. However, all of the above requirements are included in the contingency plan standards discussed earlier. Therefore, no conflictin_ requirements would be introduced through adoption of the contingency plan standards proposed in this report.

THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

This Act authorizes the Secretary of Labor to set mandatory standards to protect the occupational safety and health of all employers and employees of businesses engaged in interstate commerce. Section 6 (b) (5) deals specifically with toxic materials and other harmful agents requiring the Secretary to "set the standard which most adequately assures that no employee will suffer material impairment of health or financial capacity" from regular exposure to such hazards.

Specific requirements issued under this Act pertinent to contingency plan standards include:

1. Emergency response requirements have been issued for any facility which handles, processes, releases, or stores 4-nitrobiphenyl, alpa-Naphthylamine, 4,4'Methylene bis(2-chloroaniline), Methyl chloromethyl ether, 3,3'-Dichlorobenzidine (and its salts), bis-Chloromethyl ether, beta-Naphthylamine, Benzidine, 4-Aminodiphenyl, Ethyleneimine, beta-Propiolactone, 2-Acetylaminofluorene, 4-Dimethylaminoazobenzene, or N-Nitrosodimethylamine. In the event of an accidental release which may result in exposure to or contact with any of the above substances:

   a. The potentially affected area shall be evacuated as soon as the emergency has been determined.

   b. Hazardous conditions created by the emergency shall be eliminated and the potentially affected area shall be decontaminated prior to the resumption of normal operations.

   c. Special medical surveillance by a physician shall be instituted within 24 hours for employees present in the potentially affected area at the time of the emergency.

   d. An incident report on the emergency shall be made within 24 hours to the nearest OSHA Area Director.

   e. A written report shall be filed with the nearest OSHA Area Director within 15 calendar days of the event and shall include:

i. A specification of the amount of material released, the amount of time involved and an explanation of the procedure used in determining this figure;

ii. A description of the area involved and the extent of known and possible employee exposure and area contamination;

iii. A report of any medical treatment of affected employees and any medical surveillance program implemented; and

iv. An analysis of the circumstances of the incident and measures taken or to be taken, with specific completion dates, to avoid further similar release.

2. Similar emergency response requirements have been issued for facilities handling vinyl chloride.

The contingency requirements issued by OSHA for facilities handling the aforementioned carcinogens concur with those presented earlier for all hazardous waste facilities, with the additional requirement of filing reports with the OSHA Area Director. There are no incompatible provisions between the existing OSHA regulations and those proposed under RCRA.

OTHER REGULATIONS

In addition to the laws described above, the following acts which deal either directly or indirectly with hazardous wastes were reviewed to determine if they contained provisions related to contingency plans for hazardous waste management facilities:

-Safe Drinking Water Act (P.L. 93-523)

-Marine Protection, Research and Sanctuaries Act of 1972 (P.L. 92-532)

-Atomic Energy Act of 1954 (42 USC 2011)

-Toxic Substances Control Act (P.L. 94-469)

-Transportation of Explosives Act (18 USC 39)

-Hazardous Materials Transportation Act of 1970 (P.L. 91-458)

None of the preceeding acts were found to have applicability regarding contingency plan standards for the hazardous waste facilities to be regulated by EPA under the Resource Conservation and Recovery Act. Specifically, RCRA does not mandate regulations concerning transportation related accidents (as do the Transport of Explosives Act, the Hazardous Materials Transportation Act of 1970 and the Marine Protection, Research and Sanctuaries Act of 1972) or accidents involving the release of radioactive wastes regulated under the authority of the Atomic Energy Act of 1954. Neither the Safe Drinking Water Act nor the Toxic Substances Control Act grant authority to EPA to promulgate regulations concerning contingency plan standards.

CONCLUSION

In conclusion, none of the contingency plan standards proposed for implementation under RCRA were found to be incompatible with existing regulations, or in conflict with the authorities granted under other acts. However, facility operators may find that contingency plans must meet supplementary requirements of other governmental regulations, such as OSHA safety standards requiring supplementary fire equipment other than mentioned in the Contingency Plan Standards.

F. RELATIVE COSTS OF CONTINGENCY PLAN STANDARDS

Under the Section 3004 specifications, the design of the facility must include the goal of reducing the possibility of material dispersion to the environment. This reduces potential contingency plan costs, in that protective structures such as dikes, sumps, paving to minimize or eliminate inflow of spills into ground water, etc., must be considered regular facility costs, rather than "emergency devices". The facility costs to implement contingency plan standards are then for (the group of standards to which each type of cost is related is indicated in parenthesis):

1. Fire control and suppression systems (Response).
2. Employee protective equipment donned during emergency periods (as contrasted to protective equipment worn during material loading or handling) (Assessment and Response).
3. Emergency communication equipment (Communication).
4. Assessment model costs (Assessment).
5. Neutralizing, sorbing, or barrier materials used after or during spills (Response).
6. Contingency response costs (Response).
7. Facility diseconomies resulting from contingency considerations, such as inventory limitations (An indirect cost not related to specific groups of standards).
8. Governmental emergency services for fire, medical, and police actions (An indirect cost).

The subdivisions listed above are used as the basis for the contingency item costs given in the following section, under "Contingency Plan Costs."

Disposal costs at landfill sites in the 100 ton per day (tpd) range were estimated at $10+ per ton based on 1969-1972 costs. Because of escalating land values and construction costs, these disposal costs on at 1977 basis would be estimated at $20 per ton for new sites, and about $15 ton for existing fills.

Using an economist's rule of thumb that capital investment in landfill operations should be able to return 15 to 20 percent per year return towards profit and amortization in addition to covering operating expenses, a 100 tpd operation, 250 days per year, would need to charge $1 per ton for each $100,000 of investment in safety or environmental protection equipment.

Incinerators in the one-half to one tpd range (100 lbs/hour) were estimated to incur disposal costs of about $6.50 per ton based on 1969-1972 data. Current costs for low BTU content materials requiring pyrolysis and stack scrubber protection would be estimated at about $15-20 per ton, decreasing to about $10 per ton as the fuel quality of the material improves. Scrubber safety systems have to be tested frequently if they are to provide reliable service, and consequently, are likely to incur high labor costs.

CONTINGENCY PLAN COSTS

Relative cost estimates for the contingency items listed are given relative to 100 tpd landfills and/or a 1 tpd pyrolyzer:

1. Fire control and suppression systems, type A. As supplied by a municipal system, 10,000 gallons per minute (gpm) capacity, no annual usage, $150 to 600 per month, higher if exclusive main is installed:

   7 to 30¢/ton, landfill

   1500 gpm capacity, $30/mo. 1¢/ton, landfill
   7¢/cwt, incinerator

   Type B, pressurized or small portable systems, $800 to $30,000 (several cylinders, to truck mounted pumper: 3¢ to $1.20/ton, landfill
   16¢/cwt, minimum for incinerator

(Note, the $800 is considered as annual cost, the larger amount as a capital item).

2. Employee protective equipment: $300 per year per man.

   $3000 total assumed: 12¢/ton, landfill
   60¢/cwt, incinerator

3. Emergency communication:

Telephone -- zero allocated to contingency

Internal Alarms, $100 per year

Direct signal alarms: $1500 per year
higher for remote locations 6¢/ton, or 32¢/cwt

4. Assessment model costs

Computer model assembly

Meteorological	$20,000 to 35,000
Surface Water Hydrology	$ 8,000
Ground Water Hydrology	$ 25,000

Computer standby and data update (update user monitoring results, but lab costs not allocated on routine readings)	$ 200 per month
Met. data input, standby service (costs assumes data prepared routinely for other uses, charged at margin for standby)	$ 100 per month

Cost Recovery:

$68,000 X 20% --$13,600
plus mo. 300 X 12% -- $3,600
$17,200 over 25,000 tons gives 69¢/ton, landfill
over 5,000 cwt gives $3.44/cwt, incinerators

Non-computer model

Meteorological	$1200
Surface water (no contour survey)	$1800
Ground water	$1200

Cost recovery:

$4200 X 20% --$840

Meteorologist standby	$250 per mo.
Surface hydrologist	$150 per mo.
Ground water model update	$300 per mo.

$9240 gives 37¢/ton
$1.85/cwt.

Computer service response aimed at 10 min. max. Non-computer service aimed at 30 min. maximum.

5. Consumable supplies:

Sorbents, neutralizers, etc. estimated at $400 to 3000 per annum:	2¢ to 12¢/ton 8¢ to 60¢/cwt.

6. Contingency response costs:

Test wells drilled:	$7500 each
Test wells monitoring:	$ 300 per sample. Typical $1200 per day
Earthwork:	$ 600 per day, own equipment $2500 per day, contracted
Shut-in time:	$ 120 per half day, no revenue loss: $4000 to $5000, 5 days with 50% revenue loss.

Typical incident cost (internal costs only) 3 day shut-in, 50% revenue loss

Materials consumed: $2540
$500
$3000

Recovery of cost against revenue: 24¢/ton or $1.21/cwt, for one year

7. Facility diseconomies:

A landfill of 100 tpd should have no scale loss for inventory limitations of one day capacity or greater. For one-half day, 10 percent can be estimated, although it could be lower. For one-quarter day limit, at least 10 percent diseconomy should be expected.

For a batch incinerator, no facility diseconomy can be charged for inventory limitation as no operating time is lost waiting for batch handling. However, the operating costs of a separate storage facility may be incurred, plus transportation inefficiency losses.

8. Governmental emergency/services costs:

Local governmental costs vary widely and depend on the extra costs incurred by government because of the facility. Fire costs decrease per hour with increased usage on the department. Using a rule of thumb of $120,000 actual costs per service person, fire costs for a 25 man crew with 15 percent on-line duty per year would be $2300 per hour, or $8-10,000 per usual fire. Police costs, at 90 percent on-line duty, would be figured at one-sixth of fireman cost. Equipment charges can be estimated as an additional 25 percent of manpower.

Administrative and regulatory services of government can be estimated at $40,000 per man year. The allocation of that time to a particular hazardous waste facility would be expected to be a small fraction of the man-year. However, startup costs for all types of governmental administrative services could be high if new facilities and equipment would be required at close proximity to the disposal facility.

Total Costs of Contingency Items

This estimate excludes items 7 and 8, but includes all other contingency cost items as relevant to the type of facility. The low estimate of costs uses the lowest cost options under any relevant cost item, and the high estimate uses the highest cost option under any relevant cost item.

Incinerators: $15,600 to $55,600 per year; $3.00 to $11.00 per cwt. As a percentage of costs for a 1 ton per day operation, contingency items for a low of triple current disposal costs to a high which would represent a major multiple of such costs. For a 100 ton per day facility, such as might be used in a medium sized contract hazardous waste disposal facility, these items would represent from 6 percent to 22 percent of current disposal costs.

Landfills: $21,400 to $84,160 per year; $.85 to $3.40 per ton. These costs represent from 4.2 to 23 percent of the costs per ton of disposal for a 100 ton per day land fill, with the variation in the percentage depending upon both the range in the costs of contingency items and upon the range in costs of disposal for different types of facilities.

CONTINGENCY COSTS AT DETACHED WASTE FACILITIES

The waste treatment facility which is detached from the ultimate disposal point often fulfills a processing function, particularly by-product recovery, which is additional to the waste aspects of operation. Allocating contingency standards costs to such a facility is difficult because, ideally, the capital investment and operating costs committed to the waste stream may be small. As a general approach, it can be assumed that, however, a detached facility will have the same contingency costs per site as any other.

G. CONTINGENCY PLAN STANDARD SETS

In this section, three "sets" of contingency plan standards are presented. Each set lists a different group of standards that could be used to promulgate rules and regulations. These sample groupings are three of an infinite number of groupings that might be developed from the lists of standards in Part C. It should also be remembered that different strategies may also be applied to the listed standards in a group.

The purpose of developing the following three sets is to present three logical and rational lists of standards from which the EPA may choose for implementation. Realistically, these three sets may be supplemented and/or modified by the EPA in their developing the "best" or final set of standards.

CONTINGENCY PLAN STANDARD - SET NUMBER 1

This set of standards applies the strategy of uniform contingency plan requirements for all facilities. In the most general terms, this set reflects a lenient regulatory stance, providing much latitude in the preparation of the contingency plans by the individual facility operator. The regulatory agency would presumably provide additional guidelines to these standards for the preparation of contingency plans for specific facility types. These guidelines would serve solely as suggestions to assist the facility operator in meeting requirements at his site and dealing with particular hazardous waste(s).

Organization Standards

These standards are concerned with formalizing lines of responsibility for contingency actions. The major costs arising in organizational standards are those from any safety-related equipment, such as fire protection, breathing equipment etc., specified in

CONTINGENCY PLAN STANDARD

SET #1

ORGANIZATIONAL STANDARDS

1. Standard for Requiring a Contingency Plan
3. Defining Civil Authority
4. Defining Internal Authority
6. Facility Contingency Equipment Standards
9. Training and Drills

COMMUNICATION STANDARDS

2. Emergency Communication Equipment

ASSESSMENT STANDARDS

3. Identification of Material
4. Source and Extent of Release
7. Fire Assessment

RESPONSE AND RECOVERY

Notification of Release

1. (Activate Alarms)
2. (Notify Agencies immediately)
8. (Notify Agencies)
15. (Initiate Containment)
28. (Decontamination Equipment)
29. (Fire Alarm)
30. (Initial Response)
31. (Explosive Materials)

organizational standards. Since such specifications could as well be set under competing standards - facility design, NIOSH regulations, and local permitting, it is felt that no significant costs are generated which would be a disadvantage.

Several questions, however, covering overlaping and competing authorities arise in the organizational standards. These questions are central to the functioning and permitting of waste facilities under the Act. These conflicts between local regulation on the use of land, and regional regulation based on the authority to control water and air quality extend to the contingency planning activities as well.

The suggested format in the planning standard used the words "file with", without saying "approved by". Thus approval of the contingency plan has been left to implicit approval through the issuance of a permit. On the one hand, for a building, construction or land-use permit granted by local authority, there would seldom, if ever, be a procedural review of the contingency plan complete with comment or endorsement by the concerned local emergency entities. On the other hand, a state or regional permit granted under authority of the Act could certainly embody such review. The permit process may, therefore, provide for comment and agreement by the local authorities.

The standard for an inactive site or for post closure of a site has been touched upon in this section. The subject of post closure contingency plans is tied very closely to the contingency plan at a facility used when the facility was in an operating mode. It is assumed and logical that closure plans for a facility which are part of the operating plans, would include provisions to identify the level of effort required to be maintained after the operation mode has ceased. It is apparent that post closure contingency plans will vary dramatically with such variance dependent on (1) hazardous waste type at the facility, (2) the mode of storage, (3) the exposure of the facility to the environment and the site location/characteristics. Although post closure contingency plans would be developed as part of closure plans (Operations), the Standard in this report may be utilized to develop the necessary plan. Implicit in the standards given are assumptions about the nature of hazards, especially the limited nature of hazards, that may arise from a properly sited and operated facility. In this report, guideline longevity for the hazards was assumed to be 50 years (range 1-100 years) for most organic residues, 200 years (range 100-500 years) for certain persistent organics, and 5000 years (range 500-10,000 years) for metal element hazards. The ultimate fate of the organics is considered to be microbial breakdown and oxidations while metal elements are considered to disperse during ground water migration at tolerable concentration, even in impermeable sites (based upon a defined impermeability of 10^{-7}cm/sec). Concentrated radiologicals, however, are not considered in the longevity. Small amounts of them would be assumed to disperse to below background levels of activity in the same manner as metal elements, even if their radioactivity had a much greater longevity.

For help in preparing a list of appropriate standards for post closure, a list similiar to this Set Number 1 should be utilized with the realization that costs for equipment and manpower monitoring would need to be borne solely by the plan. Although the organizational standards, the communication standards, the assessment standards as well as the response and recovery standards would easily carry over from active operations, general post closure costs could run from $1,000 per year to $10,000 per year at a disposal facility. It is not envisioned that security costs would be extensive at a closed facility if adequate and effective closure techniques are utilized at a site. If security guards are required, such costs could be as high as $40,000 to $60,000.

The advantages of defining the organization standards allow for execution of response and recovery in an orderly fashion. Such establishment is imperative to protecting public health minimizing harmful exposure of hazardous waste releases on the environment.

Communication Standards

The standards considered for communication require that facility operators be able to summon external aid and that employees be able to summon aid internally. The standards require that the knowledge of complete inventory and storage be available and that notifications required under the Act be formally established and identified in the contingency plans. These standards seem to be minimumly different from those that a prudent operator would not ordinarily undertake on his own. The list is adequate but not exhaustive.

Additional standards, such as predetermination of language communication between all employees and supervision, or between operators of the facility and persons transiently engaged in transportation activites at the facility, may also be formulated if potential problems in this area might occur. Precedent for such standards can be found in oil spill contingency plan standards, and in the Port Safety Act. However, it was concluded that the international nature of the oil spill problems and Port traffic would not be expected at a hazardous waste facility. Any certification training requirements, internal alarms, and the proper supervision or transient personnel, would more than likely provide adequate safeguards in preventing communication problems.

Automatic warning system requirements have been generally concluded to be of little application in waste facilities, Nevertheless, incinerators generally incorporate high and low temperature control sensors. And in this case, safety equipment has been both required and important.

The question has also been raised that a central agency, such as a state or regional alarm center should receive instant automatic alerts when an accident occurs at a particular facility. The advantage of such an alert would be quick response of the state or regional facility to the accident. However, with the basic premise of facility operator preliminary assessment is considered to be most important to protection of health and the environment, little advantage would be associated with the instant alert alarm. With little advantage, any communication costs in this regard are not justifiable.

The advantages of reliable and effective communication in the event of an accident at a facility is most important in minimizing the impact of a hazardous waste accident. Costs for implementation of communication standards would be on the order of only several thousand dollars at a facility.

Assessment Standards

The costs imposed on a small facility by assessment standards are considerable. Assessment standards, are linked to siting studies, requiring provision of a considerable exploration of the natural dispersive qualities of a site before a facility is permitted to be established. Particularly important are airborne and waterborne dispersion vectors. Dispersion profile capabilities need to be established at the facility and the precedent for providing such assessments is well established with nuclear power plant facilities. The value of such information is also clearly pointed out by looking at the recent contamination problems in storm and sewage discharges from kepone wastes and the dioxine waste releases at Seveso, Italy.

Several policy considerations arise in conjunction with assessment of a non-routine release at a facility and the facility siting criteria. The problems involve transport of hazardous materials, and the treatment location of industrial hazards, in general. For example, if the standards for siting hazardous waste facilities should follow the U.S nuclear regulations example of partial isolation of risk, i.e., limiting siting to zones of low population exposure potential, then the hazard exposures in transport to such isolated sites may well be increased. The sites would also become a concentration focus for such hazards. The exposure is acceptable for organic materials to be pyrolyzed, but may be counter-productive for metal elements. In the latter case, dispersion of metal elements into the natural environment may be the preferable ultimate fate of the disposal, instead of perpetual concentrated storage. Policy decisions need to be made on whether isolated distant sites are preferable to closer more exposable locations.

The alternative approach of allocating the risk to small incinerators, smaller disposal sites, and limitation of inventory could reduce total risk of public exposure and risk at any one time. However, offsetting the risk reduction at a specific site is the fact that populations are exposed. Contingency plans for small local areas also might not require sophisticated atmospheric models since the exposures could be too rapid for them to be useful. More important would be informing the local population of preset evacuation plans and providing them with quick knowledge of wind conditions at the time of an accident. It is assumed that the policy questions raised in this area will be resolved under the permit granting process. The effect of the decision will certainly impact dramatically on event assessment costs associated with and required at the facilities. The closer a potential hazardous waste contaminant is to human population centers, the greater the committment must be to monitoring equipment and assessment standards.

In general, the question of cost effectiveness of sophisticated assessment models is closely linked to siting considerations, and contingency planning will have to reflect the siting policy. Assessment model costs on facilities including the basic data collection at a site may be on the order of $50,000 to $100,000 which emphasizes the importance of size to distribute such costs. The disadvantages of not having an adequate assessment procedure would be a serious compromise to protecting the environment and public health.

Response and Recovery

The area of greatest advantage for response standards will probably lie in providing a firm, prescriptive methodology for cleanup of spills, leaks, which are internal to the facility. Such expenditures will result in expeditious cost effective cleanup operations. Without good responses, i.e., very careful attention to housekeeping, the potential is great for the later damages of reactive residues in the surface layers of soil around handling points in the facility. Improper response could also lead to fugitive dusts, puddles of corrosive and reactive materials, and difficult control of contaminated runoff.

Training and maintenance of training in hazardous waste handling may be instrumental in improving the lack of attention of personal safety often demonstrated by the workers themselves.

The external response standards in this section are likely to be the least effective in promoting contingency actions. The standards recognize this implicitly in requiring the operator to cooperate with emergency authorities and to assist in emergency response. The open ended nature of an operator's liability with regard to external exposures, and also the need for objectivity in assessments, such as in water quality analysis, have a predictably inhibiting effect on external action. The phenomenon of inhibited reaction is a well known result of legal liability proceedings. Such reluctance has led some states to pass "good Samaritan" laws in order to compensate for any reluctance of action in this area. Thus, those standards for external action which are expected to be more effective are those where the ability of the operator to assist external actions (provide extra breathing equipment, pump and collect leachate, etc.) can be enhanced by pre-planning.

External response standards for facilities may in several cases be effectively combined with those for transportation, although this combination has not been considered in the standards. An operator has no requirement to mitigate spill of materials carried by an independent transporter, even though the incident might be outside his gate - thirty feet away. Nevertheless, the advantage in mutual agreements for assistance between operators is apparent. Agreements in the petroleum industry are common and have been executed to avoid just such a problem. By enabling those providing assistance to have expectation of financial recovery, and to be held harmless from liability for situations for which another operator is legally responsible, make mutual external response agreements viable. This pattern should also be workable in the hazardous waste disposal industry as it has been in the petroleum industry.

Contingency plan actions resulting in facility shutdown raise some concern for public hazard exposure at the generator site. At present, a generator may not be covered by the provisions of the Act, if his normal storage inventory of waste does not exceed the limits to be specified. If the generator's waste disposer is shut-in, there is no mechanism to prevent build-up of the inventory to abnormal or dangerous levels. Widespread exposure in the event of accident at the generator's facility may certainly be possible.

The costs from the Response and Recovery standards are the most variable of any of the four groups. The primary reason for such variance is the magnitude and type of non-routine spill will control the overall magnitude of control/cleanup costs. Spills into the subsurface, for example, will be both more costly and time consuming as compared to surface spills. The advantages of a quick and organized response to an event will be measured primarily in terms of basic protection to public health and environment. Costs for the most basic response and recovery contingency plan will be greater than $0.25/ton

Evaluation

This first set of contingency plan standards contains a minimal number of standard requirements. As such, it closely resembles regulations in effect or under consideration in several states. The effectiveness of this type of regulatory approach relies primarily on the competence of permit granting authority in evaluating the effectiveness of proposed plans. The most important advantage in the set of standards would be the ability of the standards to cover a wide range of facility types and sizes. In addition, administrative and other costs are kept at a minimum. The major disadvantage of the approach may be the lack of guidance provided to the facility operators in preparing specific contingency plans for their facility.

CONTINGENCY SET #2

The 2nd set of standards is addressed primarily to facilities with incinerators. It specifically includes requirements for airborne dispersion modeling. Specific requirements in all four standards areas (organization, communication, assessment, and response and recovery) have been detailed to a greater degree. This approach reflects a facility oriented regulatory strategy, and addresses a number of specific contingency plan operational requirements.

The advantages and disadvantages for the areas of organization, communication, assessment and response/recovery have been discussed in Set #1 along with general costs. Costs outlined in Set #1 would be applicable in addition to costs incurred by supplemental standards. The greatest number of these standards are in the area of response and recovery. A 10% increase in overall costs for this area is expected which may be on the order of \$0.30 to \$0.50/ton. A listing of Standards follows on the next page and includes applicable strategies.

Evaluation

The standards in this set are markedly more specific and stringent that those presented in Set #1. The additional standards may increase the effectiveness of public health protection and environmental protection. An additional advantage of the specific contingency plan standard requirements is the relative ease of determining compliance of submitted plans based on the regulation standards. The major disadvantage of this regulatory approach is a lack of flexibility. Unless provisions were made to enable the granting of variances to certain facilities from full compliance with the regulations, the requirements might prove to be excessive for many facilities, particularly the smaller operations. Such possible over-regulation presents the threat of suits claiming that the regulations may be "arbitrary and capricious". In summary, the more detailed regulations presented in Set #2 result in minimal cost increases but may provide a greater protection potential for public health and the environment.

CONTINGENCY PLAN STANDARDS
SET #2

ORGANIZATIONAL STANDARDS

1. Standard for Requiring a Contingency Plan
2. Filing the Contingency Plan
3. Defining Civil Authority
4. Defining Internal Authority
5. Response to Emergency Inquiry
6. Facility Contingency Equipment Standards
7. Information on Exposure Symptoms and Treatment
9. Training and Drills

COMMUNICATION STANDARDS

1. Pre-Contingency Notification of Nature of Hazards
2. Emergency Communication Equipment
3. Internal Alarms
4. Notification of Required Agencies

ASSESSMENT STANDARDS

1. Airborne Dispersion Model
3. Identification of Material
4. Source and Extent of Release
5. Atmospheric Release Assessment
7. Fire Assessment

RESPONSE AND RECOVERY

Notification of Release

1. (Activate Alarms)
2. (Notify Agencies immediately)
3. (Initial Report)
4. (Final Report)

Shut-Down

5. (Switching Mechanisms)
6. (Personnel Designated)
7. (Monitor Releases)

Evacuation

8. (Notify Agencies)
9. (Begin Evacuation)
10. (Evacuation Procedures)

Monitor and Delimit Affected Area

11. (Secure Entry)
12. (Monitoring Program)
13. (Sample Analysis)

Collection and/or Containment of Waste

14. (Secure Area)
15. (Initiate Containment)
16. (Emergency Storage Area)
17. (Collection and Containment)
18. (Handling of Wastes)
19. (Clean-up Emergency Equipment)
20. (Integrity of Containment Equipment)

Continued Assessment of Affected Area

21. (Monitoring)
22. (Monthly Reports)

Personnel Availability

23. (Qualified Personnel on Site)
24. (Qualified Personnel Availability)

Medical Assistance and Treatment

25. (Physician and Medical Equipment)
26. (Emergency Assistance)
27. (Treatments for Exposure)
28. (Decontamination Equipment)

Fire-Fighting and Prevention

29. (Fire Alarm)
30. (Initial Response)
31. (Explosive Materials)

CONTINGENCY SET #3

This 3rd set of standards is directed toward contingency plan standards for facilities which primarily utilize land burial and/or lagooning. The set resembles Set #2 with respect to the level of stringency associated with the standards. While the response and recovery standards are for the most part flexible, a modeling requirement for assessing water-born movement of accidentially released wastes is addressed. Again, a facility-type regulatory strategy is employed; both specific and flexible standards are included in the Set on the following page.

Costs for Set #3 would be very similar to those associated with Set #2 and, therefore, about 10% greater than Set #1. Advantages of this set also mirror the advantages of Set #2.

Evaluation

This set represents a thorough treatment of standards to ensure greater protection of human safety and the environment from accidents occurring at facilities employing land burial or lagooning. Most hazardous waste facilities will likely be of this type. A combination of specific and flexible requirements are included in the Set. As with the standards presented in Set #2, some provision must be made to enable granting of variances to certain facilities deemed exempt from certain requirements, particularly small facilities. Nevertheless, the inclusion of specific standards enables an easier measure of compliance during review of contingency plans by the permit granting authority.

CONTINGENCY PLAN STANDARDS

SET #3

ORGANIZATIONAL STANDARDS

1. Standard for Requiring a Contingency Plan
2. Filing the Contingency Plan
3. Defining Civil Authority
4. Defining Internal Authority
5. Response to Emergency Inquiry
6. Facility Contingency Equipment Standards
7. Information on Exposure Symptoms and Treatment
8. Inactive Sites
9. Training and Drills

COMMUNICATION STANDARDS

1. Pre-Contingency Notification of Nature of Hazards
2. Emergency Communication Equipment
3. Internal Alarms
4. Notification of Required Agencies

ASSESSMENT STANDARDS

2. Waterborne Dispersion Model
3. Identification of Material
4. Source and Extent of Release
6. Waterborne Release Assessment
7. Fire Assessment

RESPONSE AND RECOVERY

Notification of Release

1. (Activate Alarms)
2. (Notify Agencies immediately)
3. (Initial Report)
4. (Final Report)

Evacuation

8. (Notify Agencies)
9. (Begin Evacuation)
10. (Evacuation Procedures)

Monitor and Delimit Affected Area

11. (Secure Entry)
12. (Monitoring Program)
13. (Sample Analysis)

Collection and/or Containment of Waste

14. (Secure Area)
15. (Initiate Containment)
16. (Emergency Storage Area)
17. (Collection and Containment)
18. (Handling of Wastes)
19. (Clean-up Emergency Equipment)
20. (Integrity of Containment Equipment)

Continued Assessment of Affected Areas

21. (Monitoring)
22. (Monthly Reports)

Personnel Availability

23. (Qualified Personnel on Site)
24. (Qualified Personnel Availability)

Medical Assistance and Treatment

25. (Physician and Medical Equipment)
26. (Emergency Assistance)
27. (Treatments for Exposure)
28. (Decontamination Equipment)

Fire-Fighting and Prevention

29. (Fire Alarm)
30. (Initial Response)
31. (Explosive Materials)

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Chapter IV
TRAINING AND CERTIFICATION

This chapter deals with the separate but related issues of training and certification of hazardous waste management site operators or employees. Training is designed to assure that the appropriate personnel will possess the specific skills and knowledge required to carry out their responsibilities effectively and safely, including contingency plan implementation and record keeping. Certification provides the authorities with assurance that the requisite skill and knowledge levels are held by the employees on a continuing basis. A key issue, if both the training and certification functions are to be included in the EPA Resource Conservation and Recovery Act regulatory program, is the degree to which the certification program should be linked to the training program. An independent certification program will have, for example, an examination schedule of its own. Certification linked to a training program might require only that a certificate be filed with the regulatory authority attesting that an employee successfully completed the training course.

A second key issue is whether all hazardous waste management operators will have to undergo training and be certified, or whether experienced operators will be exempted from either or both requirements through "grandfather clause" provisions. This is a stipulation that personnel who have been carrying out the responsibilities for a specified number of years may continue to do so without having to meet the new formal training and certification requirements which are to apply to new entrants to the field.

The first section of this chapter summarizes the background of the problem. Unlike the other questions examined in this study, recommendations are made in this chapter, in the second section for training and in the third for certification. The fourth section examines the costs of the training and certification schemes recommended. The fifth section discusses alternative certification agencies.

A. Statement of the Problem

Section 3004(6) of the Resource Conservation and Recovery Act of 1976 requires that standards be implemented regarding training for hazardous waste facility personnel, as may be necessary or desirable to protect human health and the environment. Personnel in the hazardous waste management industry must perform their tasks in a consistently competent manner in order to assure public health and safety and to protect the environment. Many of the jobs associated with hazardous waste management require high skill levels. Clearly, training in these jobs is essential, whether it is acquired on the job and through experience, or through a formal course of instruction.

Certification is a common method used to document the amount and type of training that individuals have received and the skills they possess, and can be used in a regulatory program to ensure that individuals charged with specific responsibilities have this requisite training and competence. Because certification requires an assessment of the training acquired and skills possessed by an individual, it is easy to link certification to training where training is provided through formal channels, scuh as a classroom, or a training workshop. But where training has been informal, gained on-the-job, or through experience, or where training will provide only some of the required skills, certification linked to training course completion may be quite inadequate.

Where formal training requirements are implemented certification is effectively a concommitant requirement, if the training is to be verified and enforced. Course-work and training certification may be included in a larger certification program, also requiring separate examination and periodic updates, for example.

A motivated, knowledgeable work force is needed to meet hazardous waste management permit conditions. This is especially true at a landfill site where hazardous materials are disposed of under a covering of earth. The performance of such facilities is difficult to judge. There may be no product stream as in a liquid waste treatment plant or incineration facility by which performance can be measured. Thus, the personnel at such facilities must perform their jobs with certain minimum levels of competence, knowing that their actions can affect their own personal health and the welfare of the community for decades.

The subject of certification has elicited many responses from the hazardous waste management industry. The proposal that facility operators would be obliged to qualify under a mandatory certification program received overwhelmingly negative comments. The recurring theme of these comments was that meeting the performance standards to be established by EPA was an adequate measure of training, obviating the need for a certification program. An additional objection centered on the feasibility of a certification program given the many types of wastes involved, the variations in methods and systems of disposal, and the greater role of private enterprise in hazardous waste management as contrasted with waste water treatment (this last factor making proposed certification much different than the situation facing the PL 92-500 Grant Program). It seems clear that a mandatory certification program for facility operators would have to overcome strong objections from the hazardous waste management industry.

A major question concerning the usefulness of a certification program is the extent to which it brings additional assurance of safety to the hazardous waste management programs other mechanisms in the program work toward the same goal: 1) *training programs* are designed to provide a competent, knowledgeable work force; 2) *performance standards* are designed to provide environmentally sound operation; 3) *operator's permit conditions* provide an overall framework; and 4) *contingency plans* provide for proper response to emergencies and/or accidents. It can be argued that requirements in these areas may eliminate the need for certification.

Competition for reduced insurance premiums provides another incentive for accomplishing the same goals as certification. The interaction between the hazardous waste manager trying to demonstrate competent operation in order to lower its premium rate and an insurer attempting to evaluate the risks of an operation, could lead to a review framework similar to a certification program.

The main arguments for a training and independent certification program focus on the inherent hazardousness of the material being handled and on the current status of the industry. Though an independent certification program may only present a minor incremental margin of safety, given the operational requirements, inspections, monitoring, and contingency plans that will also be required, it is one that may prove cost-effective given the possible damage that an unintended release could cause. The industry is in an embryonic form: its personnel are often new to the business and new requirements are being made of the operators in the areas that they may have no experience in. The current range of capabilities found in the industry vary widely, from well managed, sophisticated, responsible companies to antiquated land fills, to fly-by-night illegal dumpers. A strong training and certification program will help raise and unify standards and help eliminate the incompetent from what is likely to prove an increasingly demanding and sophisticated industry.

The RCRA regulations will result in better planning, design, and operation of hazardous waste facilities. This should go a long way toward reducing risk and raising the level of owner and operator competence. Nevertheless, a well planned and designed facility, which will be required by strict permit requirements, does not insure the facility will be operated and maintained to function in the manner for which it was planned and designed. It is important to build in the same safeguards and level of competence in the operators of the facility as in the basic physical facility itself.

A training and an independent certification program is recommended for the hazardous waste management industry. The costs of the program are likely to prove small compared to the increase in safety and industry responsibility that should result from the program. A grandfather clause should be included for the training program, but all operators should have to meet the same certification requirements.

B. A Training Program for the Hazardous Waste Industry

The industry is new and lacks established procedures and practices which could provide an effective means to provide formal training for new personnel. It lacks industrial structure, i.e., relationships between generators of raw materials, equipment suppliers, management, workers, professional organizations, regulators, etc., which would provide a context for new personnel training. Because of this, it is necessary to have a more deliberate approach in developing training programs.

While the newness of the industry is a handicap in one sense, it is an opportunity in another. Effective training programs can be implemented more readily at this beginning stage than at later stages when routines and behavior patterns are established.

Factors Relevant to Training Program Development

Because of the opportunity for development of a completely new hazardous waste training program, special attention is warranted toward factors usually given less consideration. Some of these factors are enumerated below. They include:

(1) Program Development. A program is an organized effort to promote some end. It is not a single act. Training is a long-term commitment and must be developed and carried forth as a program. It cannot be successful if it is only a limited effort. As a program becomes institutionalized, it acquires its own momentum. In the beginning stages, however, considerable effort will be required to keep it going.

(2) Institutionalization. For a training program, the process of institutionalization includes: the development of organizational entities to manage the training activity; the assurance of continuing financial support; the continuing support of management; the emergence of a body of peers, and official sanctioning bodies; the emergence of ceremonies for the receipt of certificates and awards and the regular occurrence of commensurate social functions, etc. This process may require several years or

even decades to develop. While proper nurturing may let it happen at a faster pace, it cannot be forced, and must be given time to occur.

(3) Support. The training program must be supported fully by management and by all personnel involved (i.e., those persons who interact on the job with the trainee, those supervising and teaching, and those who are the trainees).

(4) Logistics. A training program requires deliberate management with attention given to such items as budget, instructors, facilities, and time allotment for trainee participation.

(5) Substantive Content. The specific training should be designed carefully to relate to the tasks of the job in both curriculum and specific course content. Further, the relationships between the learning and job tasks should be evident to the trainee.

(6) Modes of Training and Media. Training can take place in the classroom, on the job, by correspondence, by video tapes, etc. An attempt should be made to match budget, training mode, and effectiveness. This may require more attention in the hazardous wastes area since there may exist only limited precedents for the mode of training selected. For example, the video tape self-teaching exams mode, discussed below, may appear to be appropriate for a hazardous wastes training program. But the video tape technology for such use is new and so there are not many existing situations to confirm this assessment.

The success of any training program will depend upon how well these factors are considered. It is important not to expect too much too fast. The institutionalization must be given a chance to develop.

Training Program

A training program may not be successful on a national basis unless it can be implemented easily by the hazardous wastes industry. Since the industry is new and there is no structure to support it, federal involvement to develop the training materials would be advisable. To determine the feasibility of the development and implementation of a training program on a national basis, a model training program was designed; the complete design outline is presented in Appendix 7 while an overview of the overall program is seen in Table 26.

The model training program consists of seven modules. The modules are developed along the lines of a "need to know" theme, advocated by the Association of Boards of Certification (ABC) group (which is active in water and wastewater treatment training standardization, as described below). The seven modules are intended to fit together as an integrated, comprehensive, and complete training program.

Module 1 starts with a basic orientation about the problem of hazardous wastes and the relevant legislation which controls their disposal. The module has both "basic" and "in-depth" phases. The basic phase provides essential information necessary for all personnel. The in-depth phase is intended for the supervisory level and requires reading of the relevant laws, regulations and other pertinent reference material.

Module 2 provides training on good practices for hazardous wastes handling. Again, it has both basic and in-depth phases.

Module 3 has three options: treatment, storage, and disposal. It reviews the specific procedures for handling hazardous wastes which are unique to the respective type of facility discussed. Only the option or options associated with the facility of employment would be required.

Module 4 is site-specific training and would be taught by the superintendent of the facility or his assistant. It relates to specific procedures in dealing with hazardous wastes which are unique to the particular site.

Modules 5 provides an applied review of the relevant scientific principles which are pertinent to the facility operation. This module should be available to supplement other levels of training where necessary, but would not necessarily be required for any individual.

TABLE 26

SUMMARY OF MODEL TRAINING PROGRAMS
FOR HAZARDOUS WASTES PROCESSING FACILITY PERSONNEL

			Media			Trainees [a]				
Module	Title	Phases	Video Tapes	Reference Materials	Self-Teaching Examinations	L	O	F	S	P
1	The Problem of Hazardous Wastes and Their Control	Basic	X		X	X	X	X	X	X
		In-Depth		X	X				X	X
2	Practices Required in Processing Hazardous Wastes	Basic	X		X		X	X	X	X
		In-Depth		X	X				X	X
3	Hazardous Wastes Treatment, Storage and Disposal Site Operation	Treatment	X		X				X	X
		Storage	X		X				X	X
		Disposal	X		X				X	X
4	Site Specific Training					X	X	X	X	
5	Optional Basics		X		X					
6	Remedial Topics		X		X		X	X		
7	Continuing Training						X	X	X	

[a]
L - Laborer
O - Operator
F - Foreman
S - Superintendent
P - Professional Engineer

Module 6 reviews some of the topics which most personnel would be expected to know prior to working at a hazardous wastes facility. It is a package designed to provide the necessary information for remedial work.

Module 7 is the continuing training module. The specific content of this module would be determined by the superintendent of the facility. It could include a variety of topics. Also, the training mode for each topic could be designed to fit the circumstances. Contingency plan drills, attendance at short courses, on the job instruction, etc., are examples of training activities appropriate for this module. A minimum number of hours of training in this module would be expected annually.

To circumvent the problem of insufficient institutionalization to carry out a program, as proposed in Table 26 and Appendix 7, the use of video tapes is advocated for those modules where the nature of the training is not site-specific. There are many advantages to such a system. The equipment involved is cheap and easy to use. Also, the tapes can be viewed at the convenience of the trainee, obviating the need for a more formal setting. They can be viewed as many times as desired. The self-teaching examinations would complement the tapes and would be taken as many times as is necessary to develop the trainee's knowledge to an adequate level. Further, a formal classroom format could be used occasionally to complement the video tape and self-teaching exams format. The video tape scheme also concentrates the "front end" costs in an initial effort to produce the tapes. Further, there can be some assurance that minimal training standards are promulgated throughout the country.

The major conclusions of this investigation is that a training program for hazardous wastes handling is feasible if done along the lines outlined in Table 26 and Appendix 7. The program must be relatively easy to implement and administer and be capable of implementation by the industry as it develops. The module concept of training which uses the video tape media has these characteristics.

C. A Certification Program for the Hazardous Waste Management Industry

Two alternative programs of certification are presented: one comprehensive, and one limited. The comprehensive program provides for training and certification for all hazardous waste management employees appropriate to the level of technical knowledge and the degree of responsibility required of the candidate. The limited program is a mandatory certification scheme, which applies only at the management level.

As noted above, an independent certification program is recommended for the hazardous waste management industry. Two program alternatives are considered here: a comprehensive certification program, and a limited one.

There are two existing certification programs that are analogous to the proposed hazardous waste management certification program. They are the pesticide certification program and the waste water treatment program that operates under the Association of Boards of Certification (ABC) Program. Pesticide certification is an example of a federally administered program. The Association of Boards of Certification is an example of a collection of state administered programs aided by the EPA. The following discussion explains the workings of these two programs.

The Association of Boards of Certification (ABC)

EPA involvement in certification of waste water operators stemmed from the need to assure competent operation of waste water facilities for the protection of public health and environment. In 1972, EPA went to appropriate trade associations and together they developed the ABC. This board was to certify municipal waste water treatment plant operators only. Twenty thousand dollars was provided by EPA for a "start up" fund. The general objectives of the ABC were: 1) improvements in operator certification laws; 2) promotion of operator certification as a means to accomplish #1; 3) standardization of state regulations so operators could transfer state to state; 4) development of a uniform examination; 5) assistance to new boards. The federal agency that was designated the focal point for operator certification functions was the Municipal Permits and Operations Division, Office of Water Program Operations. In general terms, this office provided technical assistance and project grant support funds. The central theme of EPA involvement was contained in a 1975 statement made at an ABC/Tri-Regional Certification Meeting in New York City: "Through cooperative efforts with ABC, EPA goes on record in support of a nationally recognized authority for assisting state certification programs in program upgrade and development and for the adoption of mandatory certification programs by individual states."

In 1977, the ABC program is in 47 states, the Department of Defense, and the Park Service and has affiliations with several foreign countries. Two states have mandatory programs while the others have a voluntary program. ABC outputs include: 1) design of a model law; 2) classification of facilities and operators; 3) creation of a program guide and training manual; 4) establishment of examination criteria. While the program is still focused on municipal operators, there is a trend toward certification of industrial operators as well. Formerly, many industrial operations cooperated with the ABC particularly in the area of exchange of professional information. Now many states are involved in certifying industrial operators. The State of Michigan is the most advanced in this. Their proposed legislation requiring industrial certification is designed to license and regulate persons engaged in removing and disposing of liquid waste; to provide for the inspection and licensing of equipment; and to provide for the control over the disposal of liquid waste. As such, it is very similar to the procedure for certifying municipal operators.

Three major problems have inhibited the effectiveness of the ABC: 1) inability or unwillingness of many states to revise or enact new legislation or requirements to conform to ABC guidance; 2) inability or unwillingness of many states to effectively administer and enforce current certification programs; 3) inability or unwillingness of state certification examinations to meet legal questions of job relevance and validity, predicated on criteria established by the Equal Employment Opportunity Commission and the Department of Justice, Division of Civil Rights.

The ABC is an example of a certification program funded but not administered by EPA. At the inception, EPA did not want to administer a national exam or a certification program, but wanted rather to endorse an independent entity to manage mandatory programs.

Cooperation with trade associations in the establishment of the ABC has largely accomplished these goals. EPA has presented recommendations and relied upon the tool of persuasion, resulting in voluntary cooperation in dealing with the ABC. A key reason for the success of the program has been the continuity of EPA personnel who have dealt with the ABC. This has allowed a growth in confidence and mutual respect between EPA and the ABC. An additional advantage occurred because the ABC certification approach has resulted in the avoidance of criticism and opposition which might have occurred if EPA had directly administered the program. However, since EPA only provided a service, the certification process may have taken longer to develop than otherwise might have been the case.

Certification of Pesticide Applicators

Applicator certification is required by the Federal Insecticide, Fungicide and Rodenticide Act of 1947 as amended in 1972. Section 4a of this law describes the certification procedure: "the Administrator shall prescribe standards for the certification of applicators of pesticides. Such standards shall provide that to be certified, an individual must be determined to be competent with respect to the use and handling of pesticides, provided that the certification standard for a private applicator shall, under a State plan submitted for approval, be deemed fulfilled by his completing a certification form." Since 1976, most pesticides classified for restricted use may be applied only by or under the direct supervision of certified applicators.

Within the 1974 amended law two types of applicators were designated, commercial and private. Ten occupational categories for commercial applicators were established. In developing their plans, states may adopt, delete or alter these categories as needed. States may also request the EPA administrator's approval to add major categories to meet local conditions. Written examinations and, as appropriate, performance testing is used to determine the competence of commercial applicators. Testing is based on examples of problems and situations pertaining to the particular category of the applicator's certification and includes the following areas: 1) label and labeling comprehension; 2) safety; 3) environmental factors and the consequence of use and misuse of pesticides; 4) knowledge of pests; 5) knowledge of pesticides and types of formulation including hazards associated with residues; 6) equipment use; 7) application techniques; 8) applicable State and Federal laws and regulations.

The certification requirements for private applicators have a different emphasis. A private applicator must show that he possesses a practical knowledge of pest problems associated with his agricultural operation, plus the proper storage, use, handling and disposal procedures. This practical knowledge includes the ability to: 1) recognize common pests and pest damage; 2) read and understand labels and labeling information; 3) apply pesticides in accordance with label instructions; 4) recognize local environmental situations; 5) recognize poisoning situations and know what to do in case of an accident. Competence of private applicators is verified by the responsible state agency using a system to ensure that such persons are qualified to use restricted pesticide products.

Although EPA was given the responsibility for developing and publishing standards of competence, the amended law reflects Congressional intent that States assume primary responsibility for certification of applicators. State certification plans must be reviewed and approved by EPA.

The Pesticide Applicators Certification Program is an example of a Congressionally mandated EPA administered program. EPA works in cooperation with the trade associations, primarily the National Pesticide Control Association. Difficulties have arisen in convincing states that trade associations can make valuable contributions to the certification procedure. Another problem has involved establishing reciprocity among the state certification programs. Intragovernmental cooperation exists in that the U.S. Department of Agriculture is given EPA funds to run training programs. The regulatory officers involved with certification have received moderate cooperation from the private and commercial sector. Most of the opposition to the program has focused on the enforcement agencies.

Hazardous Waste Certification Needs and the Pesticide and Waste Water Certification Programs

The preceeding discussion of existing certification programs presented some variables that differ from the hazardous waste management program proposed below, and some that are similar. The hazardous waste management law does not specifically require certification; the pesticide law does. As in the hazardous waste area, a classification scheme was necessary to distinguish types of operators in pesticide application. The ten class system for commercial applicators was based on different types of application needs (e.g. forest pest control crop pest control). A hazardous waste certification program would need an analogous classification scheme based on facility types (e.g. incineration, landfill). The problems of reciprocity among states, differences in state laws and enforcement procedures and opposition from the private sector can be expected to occur in any certification procedure.

The ABC had to deal with a wide variety of facility types and is thus analogous in this respect to hazardous waste certification. But waste water engineering practices are much older than hazardous waste practices and thus certification procedures had a much deeper experience base to draw on. Another dissimilarity is the contribution to the success of the ABC made by the continuity of EPA personnel associated with the ABC Program. This fortunate circumstance cannot be planned on in designing a hazardous waste certification program.

Comprehensive Certification Program

The proposed comprehensive program for certification has four basic elements: education, training, examination, and experience. Further, the program requires certification at all levels, from laborer to superintendent. The certification requirements covering these four basic areas and each of the levels of personnel working in the facility are summarized in Table 27. The training and examination elements of the Comprehensive Program utilize the modular training program outlined in Table 26 and Appendix 7. Table 28 defines the tasks associated with each of the positions referenced in Table 27.

The education requirements shown in Table 27 are suggested entry level requirements. Personnel could be expected to upgrade from one certification class to a higher class without attaining the entry level education requirements for that class. Also, experience could be substituted for education.

Laborers would be required to become certified at the Class D level soon after they are hired. The certificate would be valid only for a specific facility. If the place of employment were changed, recertification would be required. As is illustrated in Table 28, Class C and D certification does not entail an examination upon completion of training. The required training could be administered by any Class A operator, either on site or in a formal classroom situation.

Personnel certified at Classes A, and B would be required to pass an examination appropriate to that level. Candidates for these classes would be eligible for certification after they had worked six months in a position requiring such a certification level. Certification would be required within eighteen months of assuming that position. Class

Table 27 Summary of Requirements For Comprehensive Certification at Various Levels for Employment in Hazardous Wastes Management Facilities

Position Title	Required Certification Class	Training Modules	Examination	Education (Entry Level)	Experience	
					Facility Type	Hazardous Wastes
Laborer	D	1 (Basic)	No	Eighth grade or literacy test equivalent	None	None
Operator	C	1 (Basic) 2 (Basic) 4	No	Eighth grade or literacy test equivalent	Desirable	*Six Months
Supervisor/ Foreman	B	1 (Basic) 2 (Basic) 4	Yes	High School	Mandatory	*Six Months
Superintendent	A	1 (In-Depth) 2 (In-Depth) 3 4	Yes	B.S.	Mandatory	*Six Months
Responsible Person in Charge (RPC)	A	1 (In-Depth) 2 (In-Depth) 3 4	Yes	B.S.	Mandatory	*Six Months

* Personnel would be eligible for certification after six months, but certification would be required within eighteen months.

Table 28

Tasks Associated With Various Positions For a Hazardous Wastes Processing Facility

Job Title	Tasks
Responsible Person in Charge	Has legal responsibility for operation of facility.
Superintendent	Qualified to start up, manage, and supervise the operation of a facility
Supervisor/Foreman	Qualified to supervise a particular unit of operation of set of unit operations of a facility.
Operator	Qualified to operate machinery, equipment, and processes of a facility.
Laborer	Qualified to perform tasks as directed but not to operate.

A, B, and C certificates should be renewed periodically, e.g. every three or five years. The requirement for certificate renewal could be satisfied by a specified number of hours of training in Module 7.

One unique feature of this certification scheme is that those in the professional levels of planning and design be required to take certain familiarization training to make them fully aware of the hazardous waste industry and its facilities. This is advantageous because of the diversity of backgrounds of various professional engineers, who, while they may possess the basic knowledge required, may lack specific instruction in the design and operation of hazardous waste facilities. This instruction is important because of possible risk to public health and welfare. The training specified in Modules 1 through 4 would be particularly appropriate for site designers and engineers. While there would not be an examination requirement for those professionals, a training program should be strongly encouraged. Of course, professional engineers would have to continue to be licensed in their engineering specialties as they now are.

The certification scheme of the Comprehensive Program is designed for flexibility in fitting the present variety of treatment and disposal site management practices. It is intended that job titles and appropriate certification requirements be stated in the site permit application and approved by the permitting authority. There should be at least one Class B certified person on each site, even if it is a one person operation. Certification of at least one on-site person at the Class A level should be encouraged.

The position of responsible person in charge (RPC) has been adopted from similar designations in the water and wastewater industry. The RPC would have legal responsibility for the operation and maintenance of the site. This person should be designated in the facility permit. The RPC may serve as Superintendent when the position exists, or may be the manager or owner to whom the Superintendent would report.

The advantages of this comprehensive scheme are:

1. Competent operation of a facility by personnel who possess the necessary qualifications, (i.e. education, training, and experience,) would ensure the consistently effective performance of the facility.
2. A career pattern for operating personnel is formalized, which helps to foster a professional attitude and reduce personnel turnover.
3. Documentation of training and experience levels commensurate with insurance requirements is simplified.
4. The existence of uniform standards for personnel qualifications greatly simplifies enforcement.

The disadvantages, relative to the Limited Program, outlined below, are:

1. The program would be administratively more cumbersome.
2. The costs would be greater.
3. The program would be large for the relatively small number of facilities and personnel involved in the industry nationwide.

Limited Certification Program

The Limited Certification Program is intended to be a minimum recommended certification scheme. Under this scheme an RPC would be designated, who would be required to complete all the requirements for a Class A certification under the Comprehensive Program. While certification would be limited, the training program should be developed for general distribution as outlined in Table 26 and Appendix A. Voluntary participation in the training program should be encouraged and a program of voluntary certification at other levels below Class A could be established.

The advantages of this program are:

1. It assures ease of implementation due to reduced training and administrative efforts and logistic requirements.
2. The program would be less costly to implement.
3. It provides the possibility for the implementation of a more comprehensive program which could follow at a later date.

The disadvantages are:

1. A career pattern is not established, which may result in rather high turnover rates of personnel.
2. There would be less assurance of consistent facility performance at a level which meets the requirements established by regulatory agencies, for the protection of public health and welfare.

Grandfather Clause Certification

Grandfather clauses have been part of many state water and wastewater certification programs in order to make them more palatable to the work force which would be regulated. For the same reason, there is a strong temptation to include the recommendation of such blanket clauses in this permit program. To do so, however, may sacrifice public health and safety and could impair the effectiveness of the certification program for as long as any "grandfathered" certificate holders remain in the work force. As a compromise, it is suggested that employees already in the industry be required to complete the above referenced formal examination requirements, but that training modules appropriate to the level of certification could be waived.

Summary

To ascertain the feasibility of training and certification of personnel in the hazardous wastes management industry model, programs for accomplishing these purposes were conceived. The model training program design was based upon the "need to know" theme advocated for water and wastewater treatment operators.

The model training program designed has the following elements:

(1) The training program would be administered by the industry.

(2) The training consists of seven modules. Each module has a special function. Together, the modules comprise a comprehensive training program.

(3) The use of video tape cassettes, together with self teaching examinations, is advocated as the medium for instruction for five of the seven modules.

Two alternative certification programs were outlined. They were: (1) a comprehensive program, and (2) a limited program. A comprehensive certification program is prepared with a limited program presented as a recommended absolute minimum certification. The latter would require certification of the responsible person in charge of the facility only. Some of the special features of the comprehensive certification program include:

(1) As a working premise, certification has four elements. They are: education, experience, training, and examination.

(2) All personnel associated with management and operation of hazardous wastes processing facilities would be certified. Certification would have five levels which would correspond to respective job requirements.

(3) The training requirements for the different levels of certification are integrated with the training program proposed.

(4) Certifying authority for some of the training modules may be conferred by the state to the "responsible person in charge" of the facility.

Special note should be given to the fact that the form of any training and certification programs must have an appropriate fit with the present zero-based institutional context of the industry. A strict copy of the present water and wastewater operators training and certification programs probably would not work for this reason, i.e., these programs have a well developed base of institutionalization. The video tape self-teaching examination and strong industry role and responsibility in training and certification is felt to be a form appropriate to the hazardous waste monitoring industry.

D. Costs of Training and Certification Programs

Costs of Training

Any estimates of the costs of training personnel are dependent upon the assumptions made about the nature of the training program, its extent, and the plan for its implementation. Estimates may be based upon comparisons with existing similar programs, or they may consist of hypothetical budgets. The manner of implementation of the program is another consideration, e.g. whether the training is held annually in classrooms with outside instructors, in-house sessions, on-the-job, etc. Further, a system of uniform accounting rules must be devised if costs of alternative plans are assessed, e.g. if the training is in-house the real costs of the training may be difficult to break out from other activities.

The estimate of training costs made below is based upon the video tape program outlined in Appendix 7. The estimate is limited to the cost of production and delivery of the tapes for this program. Administration of the instructional system at each facility and the investment of employee time are on-going operating costs and are not included.

An estimate of the costs associated with the production of a taped lesson may be determined from identification of the tasks required, an assignment of time in manhours for completion of the task, and the hourly rate. Table 29 is a preliminary identification of tasks.

Table 29

Phases and Tasks of Video Tape Lesson Production

Design of the Instruction:

- Conceptualization
- Detailed Lesson Plan
- Graphics Design

Preparation:

- Drawing, Lettering, etc.
- Site Visits
- Script Writing

Tape Production:

- Narration
- Taping
- Editing

Distribution:

- Tape Reproduction

Use of Tapes:

- Purchase of Equipment

Self-Teaching Examination Package

- Preparation of Examinations
- Editing, Typing, Printing, etc.

Table 30 provides an estimate of the studio costs of producing a tape; the amount is $1,800. These are the "taping" and "editing" lines in Table 29. It is probably the only cost that is constant for each lesson. The costs associated with the complete set of tasks of Table 29 are summarized in Table 31. The total cost for a tape is $152,000, including content design and execution and production. Using this cost per tape, the total cost for 30 tapes in Modules 1, 2, 3, 5, and 6 would amount to $4,560,000, or nearly $5 million in round numbers.

If a series of tapes are envisaged, a pilot tape should be developed. The pilot tape not only provides a feedback but it could give a better, i.e., more empirical, idea of costs. Some economies of scale could also be achieved by a series of tapes.

It should be noted too that "adequate" tapes could be produced probably for about $30,000 to $50,000 each. The $150,000 tapes would be for "highly effective" tapes. The argument for the more expensive effort is rather compelling if one examines the costs of not being effective. This would be in terms of trainee manhours which may not be utilized effectively and in terms of operation problems which would occur. So the more expensive version would probably be more "cost-effective."

The cost per facility for the video tape approach would depend upon the number of facilities. If 1,000 facilities existed in five years, the cost for the tapes per installation would be $5,000. The video tape equipment might run $2,000, giving an investment cost of $7,000. This is not a great amount in terms of costs of other capital equipment for these facilities. Also in terms of equivalent instructor time and associated efforts, the $7,000 is a rather modest investment.

Costs of Certification

A recently completed ABC staff report provides some basis for estimate of the costs of administering a water and wastewater plant operator certification program (ABC, 1977). According to the report, which was based on a recent survey of existing certification programs, the number of equivalent full time staff ranged from 0.2 to 1.5 per 1,000

Table 30

Costs and Use of Video Tape Production Facilities

Studio Time:	$200/hour which includes studio and staff; about six hours are required to produce a 30 minute tape which includes two hours for editing.
Master Tape Cost:	$150/hour
Cost of Production of a 30 Minute Master Tape:	Six hours @ $200/hour plus four hours @ $150/hour, or $1,800.
Cost of Duplicate Tapes:	About $50 per cassette.

Table 31

Cost to Produce a Typical 30 Minute Video Taped Lesson

Design of the Instruction: 500 hours @ $50/hour	$ 25,000
Preparation: 2,000 hours @ $50/hour	100,000
Self-Teaching Examination Package: 500 hours @ $50/hour	25,000
Tape Production: $1,800 + $200 for Narration	2,000
TOTAL	$152,000

certified operators or active certificates whichever was higher. The mean and median response was 0.7 personnel/1,000 operators. There was a trend toward greater manpower requirements as the size of the certification program decreased. There were 0.9 equivalent personnel/1,000 operators currently employed in programs which certify up to 1,000 operators. Only 0.6 personnel/1,000 operators were employed in programs certifying over 3,000 operators.

There was almost universal agreement as to the need for more staff, on the order of approximately 2-1/2 times the current level. On the average, those responding suggested at least one full time staff per 1,000 operators for the largest programs, up to two or three per 1,000 for the smaller programs.

Because of the relatively small size of the proposed hazardous waste certification programs, it can be assumed from the above that approximately three full time staff personnel per 1,000 certificates would be required to effectively administer the program. At an approximate cost of $25,000/staff person, the total cost for the program would be $75,000/1,000 certificates. This estimate includes costs for salary, fringe benefits aad overhead, and assumes a mix of clerical and professional personnel.

The above estimate is applicable to the comprehensive certification program previously proposed. Costs could be reduced if the limited certification program were instituted. Costs per 1,000 certificates, however, would probably be greater.

E. Alternative Certifying Agencies

The foregoing discussion examines two existing certification programs currently being used to enhance the effectiveness of environmental protection legislation. This study has considered a variety of other alternatives, most of which have characteristics that might benefit a hazardous waste operators certification program.

In reviewing certification alternatives it has been necessary to distinguish two separate functions that are present in most such programs:

training and verification of competence. In some programs these are carried out by a single organization, in some by separate organizations. The study considered the following categories of organizations for performance of one or the other, or both, of these functions:

1. The Federal Government
2. State or local government agencies
3. A trade organization or professional society
4. Academic or vocational schools
5. Employers
6. Trade unions.

The earlier discussion covered examples of two of these alternatives. The pesticide program is carried out directly by the Federal Government. The ABC waste water treatment program is an affiliation of trade organizations acting as professional societies.

The remaining categories are discussed below. In most cases the functions described are carried out by separate organizations. For this reason, groupings of these organizations are discussed.

State Governments/Academic and Vocational Schools

Teacher certification is an example of a widely accepted practice in which the two functions are often separate. A typical state certification program is based on a set of basic course requirements coupled with opportunities to use continuing education to establish eligibility for higher pay status. Most states accept transcripts of specified academic course work as proof of accomplishment. In them, the certification process is carried out by a state agency and consists of verifying that the course content and academic standards in the training institution relied upon were appropriate to provide the desired skills. Some local governments conduct examinations to establish, independently, that the required standards have been achieved.

Trade Unions/Local Government/Federal Government/Employer

Apprentices in craft unions take part in a variety of training programs provided in large part by the unions under supervision of the Federal Department of Labor Bureau of Apprenticeship Training (BAT). Training consists of a combination of on-the-job experience that might be considered as supplied by the employer, and formal training provided by the union. For some skills, such as typesetters, proof of competence is established through examinations administered by the unions under BAT supervision and establishes the apprentice's right to the status and pay of a journeyman. For others, particularly such building trades as plumbing and electrical work, proof of competence also requires examination by state or local governmental agencies to determine not only that the worker has the requisite manual skills, but also that he is familiar with applicable requirements of the building code.

Because of the uniqueness of the hazardous waste management industry, the analysis of certification alternatives did not concentrate on assessing the comparative success of one or another existing certification program or the degree of similarity between waste management certifications and existing certification programs. Instead, the evaluation effort sought to develop a combination of elements from existing programs that would take into account the selective merits of uniform interpretation of standards, the importance of ensuring interchange between current practitioners and the certification process, and the availability and location of existing facilities and personnel for administering the certification program.

The staff analysis resulted in the construction of a composite of the alternatives described above. The composite certification process would utilize course credits as partial proof of accomplishment. The course requirements would be set by the Federal EPA or, in states that had opted to carry out their own hazardous waste control program, by the state agency filling a comparable regulatory role. Once the course content had been adequately defined by the regulatory body, state university extension services would be enlisted to undertake the proposed series of courses. Such extension services may utilize either instructors drawn from state academic institutions, or may contract for the service of individuals or organizations not connected with such institutions. In an appropriate case, the instructor might be the director of operations for one or another of the hazardous waste management firms, and those courses could be given on the premises.

The individual seeking certification would be required to enroll in, attend, and pass examinations for the assigned course. The cognizant regulatory agency would verify the applicant's accomplishment both by reviewing the course content and by obtaining satisfactory documentary proof of satisfactory course work.

The procedure outlined would give a partial national standard to allow some mobility of workers, but be subject to the equal standard option for individual states. It would use existing facilities and provide an opportunity, if not a requirement, for current practitioners to play a leading role in course formulation and instruction.

APPENDIX 1

EXAMPLES OF INSTITUTIONS THAT PROVIDE FINANCIAL RESPONSIBILITY AND CONTINUITY OF OPERATIONS

In examining the alternatives for the maintenance of financial responsibility and continuity of operations by hazardous waste disposers, we investigated potentially analogous mechanisms employed by a variety of institutions and several pieces of federal legislation. The results of the research were reviewed with attention focused on the basic structure rather than on the operational details. The following are:

(1) The Oil Pollution Liability and Compensation Act: An Example of a Group Liability Fund.

(2) The Federal Deposit Insurance Corporation: An Example of a Group Insurance Group.

(3) The Federal Savings and Loan Insurance Corporation: An Example of a Group Insurance Fund.

(4) The Maryland Savings Share Insurance Corporation: An Example of a Group Insurance Fund.

(5) The Mutual Central Savings Fund: An Example of a Group Insurance Fund.

(6) The Ohio Workmen's Compensation Program: An Example of a State Insurance Fund.

(7) The Nuclear Energy Liability - Property Insurance Association: An Example of an Insurance Pool.

(8) The Swine Flu Program: An Example of a Type of Federal Insurance.

(9) Federal and State Strip Mine Legislation: An Example of Provisions for Continuity of Operations.

(10) Cemetery A: An Example of Provisions for Continuity of Operations.

(11) Cemetery B: An Example of Provisions for Continuity of Operations.

1. The Oil Pollution Liability and Compensation Act: An Example of a Group Liability Fund

The potential for enormous damage and cleanup expenses in the event of an oil spill from either a vessel or an on-shore facility has prompted the search for liability protection. The Oil Pollution Liability and Compensation Act contains elaborate provisions for establishing a fund as well as defining the limits of liability. The proposed House Act mandates the Secretary of Transportation and the Secretary of the Treasury to form and administer a $200 million Comprehensive Oil Spill Liability Fund. This fund will be made up of fees from refineries and terminals, monies from liable parties and all monies from civil or criminal penalties and fines. The fund is designed to pay damages and claimants in four areas: 1) removal costs; 2) injury of property; 3) injury of natural resources; and 4) loss of profits or impairment of earning capacity.

In addition to this fund, the Secretary shall establish limits of liability. These limits take two forms, a maximum figure for certain facilities and a sliding scale based on type and size of vessels. Fifty million dollars is the top figure for on shore facilities in the former case. An example of the latter arrangement occurs with small, inland barges where liability is set at $150 per ton of vessel.

The owner or operator of a vessel or facility must demonstrate evidence of financial responsibility sufficient to satisfy the maximum amount of liability. Such evidence is insurance, a guarantee surety bond or qualifications as a self-insurer.

In the event of a spill, the owner or operator of the vessel or facility is made,in the words of the act," strictly liable for all claims up to reasonable limits, while the owner of the oil carries the burden for claims exceeding those limits, contributing his share through his contribution to the fund."

2. The Federal Deposit Insurance Corporation: An Example of a Group Insurance Fund

The Federal Deposit Insurance Corporation (F.D.I.C.) was created under the Banking Act of 1933. The deposit insurance program was intended to restore confidence in the banking system, eliminate "runs" on banks and protect individual depositors as well as the nation's money supply.

The Deposit Insurance Fund is supported by annual assessments of member banks. Banks are required to file condition reports four times per year from which F.D.I.C. averages out total yearly deposits. The banks must pay 1/12 of 1% of these averaged total deposits. This is estimated for the 15,000 F.D.I.C. member banks and from this sum is deducted administrative costs and reserves set aside for bank failures. One-third of the remaining sum is credited to the Deposit Insurance Fund and the other two-thirds goes to the banks as credit against next years assessment (on a pro rata basis). The total cost of Federal Deposit Insurance, then, to a member bank is 1/27 of 1% per year's averaged deposits.

In the event that the Fund reserves are inadequate to meet its obligations, F.D.I.C. has a three billion dollar drawing authority from the U.S. Treasury. In order to reimburse the fund, F.D.I.C. may liquidate some assets or reduce (or eliminate) the amount of credit going to the banks. F.D.I.C. does not provide minimum or maximum amount requirements for the Fund, however studies made several years ago (when F.D.I.C. increased its insurance maximum) reported that the Fund, through the years, was "adequate" because it had kept pace with bank failures and other expenses. In 1934, when F.D.I.C. was established, the ratio of insurance fund to insured deposits was 1.61 -- today the ratio is 1.18.

If a bank fails, it is closed by the chartering agency (e.g. the state bank agency) which names the F.D.I.C. as receiver. The F.D.I.C. then either arranges for the purchase of the deposit liabilities (by another bank), or arranges to pay off the depositors. This is determined by which costs F.D.I.C. less.

The greatest loss sustained by the F.D.I.C. deposit insurance fund was upon the collapse of the U.S. National Bank in San Diego in 1974. After liquidation of all the assets (which the Crocker National Bank did not want), F.D.I.C. lost 150 million dollars. The F.D.I.C. net losses from all the bank failures from 1934 to 1974 totalled less than 150 million dollars.

The F.D.I.C. has six factors which they use in determining the suitability of an applying bank. They are the following: 1) financial history of the bank; 2) adequacy of the capital structure; 3) future earning prospects; 4) character of the management; 5) convenience and needs of the community to be served; and 6) consistency of the corporate powers with the powers of the bank -- i.e., it must be a corporation and it must be a bank of deposit. The banks which have been refused membership were refused largely due to management character and/or lack of capital. The F.D.I.C. has little control over changes in management, although there has been a bill on the Hill for several months, which would allow the F.D.I.C. a voice in management changes.

3. The Federal Savings and Loan Insurance Corporation: An Example of a Group Insurance Fund

The Federal Savings and Loan Insurance Corporation is the insurance arm of the Federal Home Loan Bank Board. It was created as part of the New Deal Legislation in 1934, under the National Housing Act, Section 402A. F.S.L.I.C. is a government agency (all civil service), however, it is self-supporting and receives no government appropriations.

The F.S.L.I.C. Insurance Reserve Fund (I.R.F.) now total approximately 4-1/2 billion dollars. When the corporation was established, there was a stock issue to set up the corporation, and a percentage of that was used to create the fund. F.S.L.I.C. requires an entrance fee of 3/10 of 1% of all insurable assets of an entering savings and loan association. There is a yearly assessment of 1/12 of 1% of averaged deposits per association. Neither the initial fee nor the yearly assessemnt is refundable. The Act creating F.S.L.I.C. specified no minimum or maximum for the fund. F.S.L.I.C. has a line of credit with the U.S. Treasury if their reserves are not enough to meet their obligations.

In the 1960's, the Secondary Reserve Fund (S.R.F.) was established as a result of an unusually large number of "pay-outs", thus stimulating concern about the adequacy of the I.R.F. The member S&L associations were charged a second yearly assessment which went into this fund. Recently, it was decided that the S.R.F. was no longer necessary. It is being "phased out" and the member S&L's are being refunded their money from the S.R.F. The S.R.F. could be reopened if the F.S.L.I.C. board of directors felt that the additional funds were needed.

Each member S&L must establish a Federal Insurance Reserve Account and F.S.L.I.C. may assess members to draw on this special account. The balance must represent a certain percentage of the total savings held by the association:

After 4 years the balance must be 1% of savings.
After 10 years the balance must be 2.5% of savings.
After 16 years the balance must be 4% of savings.
After 20 years the balance must be 5% of savings.

The maximum balance required is 5% of the total savings.

The Federal Home Loan Bank Board requires that all member S&L's undergo a detailed examination once a year.

The pay-out is, of course, only made if nothing else works. F.S.L.I.C. is permitted to do any number of things to maintain the stability and safety of a member S&L, including: making loans, contributions, purchasing assets, setting up mergers and drawing up "rehabilitation agreements" in which F.S.L.I.C. temporarily assumes management of the troubled association. When an association does go into default, F.S.L.I.C. pays off the savers in cash up to the limit (e.g., $40,000 on an individual account). The last pay-out was in 1971 to a S&L in Seattle. The largest pay-out ever made was approximately 90 million dollars on the closure of a Chicago S&L in the 1960's.

The general factors determining membership qualifications are similar to those of the F D.I.C., including: the financial stability of the S&L, the competence of the management, and the needs of the community to be served. A S&L eligible for charter, will be granted it conditional to acceptance into F.S.L.I.C.

4. The Maryland Savings Share Insurance Corporation: An Example of a Group Insurance Fund

The Maryland Savings Share Insurance Corporation (M.S.S.I.C.) was created by statute June 1, 1962 (Article 23, Chapter 131, Sections 161 MM-161XX of the Maryland Code). It is a non-stock, non-profit corporation owned by 136 member savings and loan associations. Since Maryland requires that all S&L's be fully insured, M.S.S.I.C. serves to cover those S&L's which: 1) are too small to fulfill the F.S.L.I.C. regulations ; or 2) prefer the flexibility permitted by M.S.S.I.C.

When M.S.S.I.C. was established, the Governor appointed a Blue Ribbon Commission which reviewed the assessment procedures of such similar organizations as F.D.I.C., F.S.L.I.C., the Massachusetts Central Savings Fund, and the Ohio Guarantee Fund. They decided that 2% was a sound percentage. This means of assesseent is unusual. Upon becoming a member of M.S.S.I.C. each S&L association must post 2% of its free share accounts. One-half of this capital deposit must be paid upon acceptance, one-quarter is paid six months after, and the final quarter is paid twelve months after acceptance.

The capital deposit is semi-annually adjusted according to the increase or decrease of a member association's total savings. If they increase, the S&L must pay the difference and if they decrease, the S&L receives a cash refund. There is no annual premium. The capital deposits are refundable to a member upon withdrawal fom M.S.S.I.C. M.S.S.I.C. is required, by law, to retain all net earnings.

The Deposit Insurance Fund totals 32 million dollars. When M.S.S.I.C. was created, it was required to have at least 25 member S&L's with an aggregate total of free share accounts of at least 25 million dollars. The initial capital deposits and the semi-annual adjustments support this Fund. M.S.S.I.C. has lines of credit (45 million dollars) with commercial banks. Their investments are in high-grade corporate and government obligations, with no more than 10% in common stock.

The Central Reserve Fund (CRF) was set up to provide for emergency lending to member S&L's. As of September 30, 1977, the CRF will have approximately $12,500,000 in assets. The capital derives from the sale of "capital notes" of $100.00 each. The assessment per association varies: 1) 1/2 of 1% of member's assets of S&L's with less than 75 million dollars in assets; and 2) 1-1/2 of 1% of member's assets of S&L's with 75 million or more in assets. Payments for the capital notes are due quarterly. In the event that the CRF is liquidated, members will be refunded their share.

M.S.S.I.C. must accept all applicants providing they meet the requirements set forth in the Maryland Code and in M.S.S.I.C.'s rules and regulations. These include certification by the state commissioner of the applicant's fiscal affairs, solvency and management. Each member must maintain a liquidity fund equal to 6% of its total free share accounts. They must all enter with a "Reserve for Losses" of 6%, which may go only as low as 3%. The largest pay-out ever made by M.S.S.I.C. was $300,000 in 1963. It was fully recovered upon liquidation of assets.

5. The Mutual Central Savings Fund: An Example of A Group Insurance Fund

The Mutual Central Savings Fund (F.C.S.F.) is a tax-exempt, non-profit deposit insurance corporation for mutual savings banks in Massachusetts. It was established in 1932 by Chapter 44 of the Massachusetts Code. Savings banks are required by Massachusetts law to be mutual -- they have no shareholders and their main objective is to accept deposits with a greater part of their business involved in home mortgages.

The M.C.S.F. insures deposits in full up to the legal limit which varies according to the type of account. There are four types of accounts: 1) individual accounts - $45,000; 2) term or contracted accounts - $100,000; 3) corporation accounts - $150,000; and 4) non-profit, tax exempt organization accounts - are insured in full to an unlimited amount. The insurance also covers any interest which might accumulate.

Each year the member bank is charged an assessment of 1/16th of 1% based on the deposits of the last fiscal year. This percentage was established by statute, although there is a provision in it that the Board of Directors may ask the Commissioner of Banks for a reduction in the percentage.

The decision to change the assessment is usually determined by the ratio of the insurance fund to insured deposits and also by comparison of this ratio to similar institutions. For example, in the last fiscal year, the M.C.S.F. ratio was 1.419 which comapres favorably to the F.D.I.C. ratio of 1.18. There are no other fines or charges.

In Massachusetts, mutual savings banks, by law, must be a member of either the M.C.S.F. or F.D.I.C. If they are a member of both, F.D.I.C. insures the first $40,000 (their limit) and the M.C.S.F. insures anything above that to $45,000 (their limit). There have been no new applicants since the late 1940's. Since new applications are so rare, the M.C.S.F. has no established format for charter applicants (all mutual savings banks must be state chartered).

The Deposit Insurance Fund (DIF) was established by statute in 1934 and as of October 31, 1976, totalled approximately 180 million dollars. Although there have been no failures in the history of the Fund, they do have lines of credit with commercial banks and the assets of the failed bank as reserves in case the fund is not adequate. The M.C.S.F. is empowered to do "anything necessary" to prevent bank failure, e.g. extend loans, arrange mergers, etc. As of the last fiscal year, the DIF has $1.44 of deposit insurance for every $100.00 of insured deposits.

While the DIF is to protect the depositors, the Liquidity Fund (established in 1932) generates extra money for emergencies (e.g. unusual deposit withdrawals) and totals 11 million dollars. This fund is stable and takes in no assessment money. In the event that the Liquidity Fund needs more money, the M.C.S.F. may charge a second assessment to the members. M.C.S.F. may also sell commercial paper on the open market to generate more funds. This commercial paper would normally mature in 60-90 days. The investments for both the DIF and the Liquidity Fund are restricted to "highly liquid short-term" U.S. government securities.

In the event of a merger, the full assets and liabilities of the merging bank are determined. There should be a surplus, normally between 8-9%, as a reserve which is still available to the depositors. If the surplus is not adequate, the M.C.S.F. will cover the balance.

If a bank is in serious trouble and is considered unsafe and unsound by the Commissioner, she may certify it to the M.C.S.F., and they must do whatever necessary in order to insure the safety of the depositors. This has only occurred 4-5 times in the history of the M.C.S.F. The most recent one occurred in 1971 as a result of mismanagement. When the M.C.S.F. steps in to prevent closure or facilitate a merger, etc., the yearly assessment fee is not refundable.

6. Workmen's Compensation: An Example of a State Insurance Fund

The state of Ohio requires that any employer with one or more employees have worker's compensation insurance. This includes domestic help who earn more than $160/quarter. Ohio has an exclusive state insurance fund. Employers may self-insure if they meet the prescribed standards.

Insurance by this fund is not effective until both an application and a premium have been submitted. An advance deposit is required based on 8 months estimated payroll at a rate based on the employer's classification. There is a $10.00 minimum deposit for new coverage. The premium changes with each biannual reporting period according to payroll changes. There is a fee charged each reporting period to cover administrative costs -- 9.5 cents for every $100.00 of payroll with a minimum of $3.00.

The rates change every July 1 according to the classifications and claims for that year. In the past several years, the rates have steadily risen with an increase of 30% last year. The increase is due primarily to the increase in the cost of disability benefits. A rate change is decided upon by the Acturial Agency, with approval coming from a three member Industrial Commission.

Another fee, created by the Ohio legislature is the Disabled Worker's Relief Fund Excise Tax which is $.05 per $100.00 of payroll. The fund has 1-1/2 billion dollars in reserves, with their investments restricted to Blue Chip stocks. No speculation is permitted.

The State Fund insures approximately 250,000 employers. Each reporting period between 25-30,000 accounts are allowed to lapse. During this time, the accounts are not covered. In the event that a company goes bankrupt, the Fund obtains the final payroll as of the last operating day. They apply the advance deposit towards what is due. If there is a credit, then the comapny receives a refund; if money is due, the Fund turns the case over to the Attorney General's Office who deals with it through the bankruptcy courts.

The advantages of an exclusive state worker's compensation fund, as listed by a fund administrator are: 1) The rates of the state fund, though high, are "significantly less" than those of private insurers; 2) There are definite advantages for the employees, especially if their employer has not complied with the regulations. They may either bring a civil suit against the employer or they may file a claim with the state. In the latter case, the Fund will service the claim and then bill the employer for all costs; 3) Since a state-administered fund is not a profit making organization, it is more likely to look out for its clients interests. The operating expenses are substantially lower as well; 4) More and more private insurers are giving up worker's compensation insurance.

In order to qualify as a self-insurer, a company must fulfill ten requirements: 1) have a minimum of 500 employees; 2) have a minimum annual premium of $50,000; 3) have been in operation in Ohio for a minimum of 2 years; 4) be able to prove financial solvency; 5) have a separate Ohio bank account for worker's compensation insurance, or if it is an out-of state comapny, it must be sponsored by an Ohio bank; 6) give a thorough description of its safety provisions; 7) outline how it would execute claims; 8) post a performance bond based on the state fund premium; 9) provide the same benefits as the state fund; 10) have a minimum of $100,000 and a maximum of 1 million dollars in the insurance account.

The bond required is either in a surety bond or is with the treasurer of the state. Self-insurer's financial statements are required once a year and all lost time claims are filed with the Bureau of Worker's Compensation. Special examinations are only performed when a complaint is filed against an employer.

7. The Nuclear Energy Liability-Property Insurance Association: An Example of an Insurance Pool

There are three insurance pools which provide insurance for the nuclear industry. The Nuclear Energy Liability - Property Insurance Association (NEL-PIA) is one of these. It provides two types of insurance, liability and property insurance coverage. The operators of nuclear facilities and their suppliers are covered for any liability they may incur as a result of bodily injury or property damage resulting from a nuclear accident. This coverage provides financial protection for the public. The property insurance covers damage to the property of nuclear facility owners.

Since nuclear liability insurance's inception in 1957, the total insurance available has steadily risen, totaling $140 million in January of 1977. This total is reached by the combination of NEL-PIA's pool and the other pools through reinsurance agreements. Property insurance in 1977 totaled $220 million.

Beginning in August of 1977, $30 million of contingent liability capacity will become available. This 'Retrospective Premium Plan' incorporates the most recent legislation renewing the Price-Anderson Act. It provides that power reactor operators be assessed a retrospective premium up to a maximum of $5 million per reactor by the pools, should a nuclear incident result in liability losses which exceed the pool's primary $140 million protection. Thus, a buffer is formed should any operator be unable to meet this assessment at the time of loss. At a later date the pools would seek repayment of any such defalut from these operators.

By the end of 1976, the accumulation of the premium income earmarked for losses amounted to $54 million. Should losses exceed this sum, the pools wuld make up the difference based on their degree of participation in the pool up to the $140 million limit of the liability policy.

The liability insurance rates charged by the pools are established by the Insurance Services Office. Among the factors involved in liability ratings are the size, type and location of the facility. An average nuclear power plant would pay about $262,000 annually for liability protection with the lowest rated reactor paying $197,000 and the highest rated paying $524,000.

8. The Swine Flu Program: An Example of a Type of Federal Insurance

The "National Swine Flu Immunization Program" of 1976 contained a provision that provided insurance in case of an injury or death death that resulted from the program. The pertinent text reads:

> "The Attorney General shall defend any civil action or proceeding brought in any court against any employee of the government or program participant (or any liability insurer thereof)."

Furthermore, the government would cover the expense of both in and out of court settlements. If however, a participant in the program was clearly negligent and their negligence resulted in damages, then the government can try to recover costs from that participant. In effect, this approach represents insurance for the public and any participant in the program who faces liability not caused by his own negligence.

9. Federal and State Strip Mine Legislation: An Example of Provision for Continuity of Operations

The Mineral Leasing Act of 1920, and its subsequent amendments, specifies the reclamation requirements of Federal strip mined lands. The operator's liability shall extend for at least five years after the first planting of new vegetation. The maximum liability shall not exceed ten years after the first planting. Bonds shall be furnished in sufficient amounts to ensure reclamation in accordance with reclamation standards, and the terms and conditions of the lease.

The mining plan shall be enforced by a combination of a performance bond, reports and inspects for compliance. The performance bond shall be at least $2000, and shall be an amount determined by the cost of reclamation.

State regulations tend to require either a bond based on a dollar figure per acre or a bond based on the total cost of reclamation. Therefore, amounts of these bonds vary considerably. At the low end of the scale are the states of Virginia, Missouri, Kansas and Arkansas which require between $500 and $1000 per acre. Oklahoma, Maryland, Illinois, Indiana, West Virginia and Kentucky require higher levels of bonding ranging from $600-%5000 per acre. Often they specify either a fixed sum or a charge per acre whichever is higher. A number of states set bond levels at the cost of total reclamation. Frequently these states establish a board to establish the bond to insure performance of duties. Such states include Ohio, New Mexico, Colorado, Texas, Washington, Wyoming, Iowa and Montana.

Alabama requires that the amount of the bond shall be $1200 per acre but not less than $10,000 per permit. Sixty percent of the bond shall be released when the first stages of reclamation are completed. Tennessee has a similar conditional release clause. The amount of the bond shall not be less than $1000 per acre. After initial planting of vegetation cover in accordance with the approved revegetation plan, the bond may be reduced to $500 per acre. This amount shall remain in force until safisfactory revegetation survival has been accomplished.

10. Cemetery A: An Example of Provisions for Continuity of Operations

Cemetery A was established within the last year, when the cemetery bought out a neighboring one. The burial plots range in price from $250 - $700, depending on location.

In creating a perpetual endowment fund, the state of Virginia requires that the cemetery corporation start with a minimum initial deposit of $25,000. With the sale of each lot, a minimum of 10% of the sale must go into this trust fund. The principle is never touched, and the interest provides for maintenance, security, and perpetual monitoring. The trust fund is managed by a trustee. In the case of one of the cemeteries (before the merger), the trustee was the National Bank of Fairfax.

Regulations concerning use of the cemetery land are set out in the cemetery's charter. This charter states that the land may only be used as a cemetery. Purchasers of burial plots are buying only the burial rights, not the land; therefore, they are not required to pay any taxes. The cemetery corporation pays taxes on the land to Fairfax County. The burial rights may be sold to anyone, at any time, for any amount of money; or they may be donated to a church or a charity.

11. Cemetery B: An Example of Provisions for Continuity of Operations

Cemetery B is a profit-making organization established in 1917. It occupies 40 acres [illegible]the size of the original site), and has not been completely developed. The price of the plots vary according to size and are only raised on the basis of the tax structure in Arlington County.

According to the law of Virginia, an initial deposit is required in order to establish a perpetual care trust fund. The cemetery corporation uses a percentage of the cost of the grave site (the percentage varies according to the cost of the site) to establish a trust account. The trust accounts are pooled, and this pool is administered by the chairman of the corporation, acting as trustee. In the event that the chairman cannot act as trustee, the trusteeship is assumed by the board of directors. Six to seven years ago, Virginia passed a law establishing the conditions for payment into this fund. It may only be on a percentage basis, no annual payments may be required. The state is the only regulatory agency.

In purchasing a burial plot, the customer is buying the land, not just the burial rights to that land. The deed given to the buyer of a site states only that the corporation conforms with the covenants specified in the company charter.

APPENDIX 2

STATE HAZARDOUS WASTE REGULATIONS

Research into state hazardous waste programs was performed in order to gather data concerning state positions on the options involved in providing for financial responsibility and continuity of operations for hazardous waste disposal firms. These alternatives are summarized in fact sheets on the follwoing states: California, Idaho, Kansas, Maryland, Ohio, Oklahoma, Oregon, Texas, Washington, and Wisconsin.

FACT SHEET: California

1. State of the Legislation: California's present hazardous waste management law and regulations represent a pioneer effort in the area of hazardous waste identification. The proposed regulations (due for public hearing August 16, 1977) primarily concern changes in permitting procedures and in the fee structure.

2. Insurance: no requirements

3. Bonds: no requirements

4. Fees: The proposed regulations require that off-site and on-site operators pay a fee to the state of $1.00/ton. There is a $2500 maximum per facility. The fees cover Department of Health Administrative costs since California is the only state with mandatory cost recovery for a state-administered program.

5. Land Deeding: no requirements

6. Land Covenants: no requirements

7. Access/Easements: no requirements

8. Other: The California Department of Health is working with disposers and manufacturers on long term care plans. Nothing has been resolved at this time, however, they expect something within the year.

FACT SHEET: Idaho

1. State of the Legislation: The Idaho Solid Waste Management Regulations and Standards were adopted by the Board of Environemntal and Community Services and termed effective on June 28, 1973. In Idaho, hazardous waste management is regulated through the Conditional Use Permit provisions of the regulations and is worked out on a case-by-case basis.

2. Insurance: no requirements

3. Bonds: At present, only one hazardous waste site exists in Idaho, it is privately owned and operated and is located in an abandoned Titan missle silo complex. Due to the unusual site qualities, a bond was not required upon initial permit approval. Recently it was decided to require a surety bond (amount undecided) to cover and provide for permanent closure of an artesian well on the site.

4. Fees: no requirements

5. Land Deeding: There is a possibility of establishing deeding provisions, however nothing has been resolved.

6. Land Covenants: no requirements

7. Access/Easements: no requirements

FACT SHEET: Kansas

1. State of the Legislation: The Kansas Solid Waste Act was amended in 1977 to provide for complete control of hazardous wastes. The Department of Health and Environment is in the process of promulgating rules and regulations.

2. Insurance: The Amended Act requires "the permittee to provide surety bond, cash bond or liability insurance, including coverage against non-sudden occurrences, or any combination thereof." The liability insurance for disposers will be determined by the state and will vary depending on the site. Only 1 site has been permitted so far and they were required to have $300,000 liability insurance.

3. Bonds: "Within 30 days following the effective date of the permit, the permittee shall establish an escrow account with a bank with conditions and instructions suitable to the Department. At this time, the permittee shall place a $50,000 surety bond in such account. In lieu of a surety bond, the permittee may post cash or eligible securities deemed equivalent to cash... The permittee shall have the options, at anytime, of replacing a surety bond with cash or eligible securities deemed equivalent to cash."*

"Until the initial $50,000 escrow account plus annual cash payments equals $100,000...the permittee shall make an annual payment of $5,000 to the escrow account within 30 days after the anniversary of the effective permit date."

The amount is determined per site and should be adequate to provide for maintenance, monitoring and closure fees in the event that the state is forced to close the site.

"Five years following the certification date that proper closure is complete the $50,000 bond or equivalent case established in the escrow account shall be returned to the permittee. After ten years has expired, all remaining monies in this account shall then be returned to the permittee."

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*All quotes from: State of Kansas, Special Conditions to Permit, Department of Health and Environment, Topeka, Kansas.

(Kansas cont'd)

4. Other Accounts: "The permittee shall also establish a separate escrow account...which shall provide the Department with monitoring funds for perpeutuity or until the account is terminated at which time all remaining monies shall be deposited in the state of Kansas general fund. Annual payments of $1,000 shall be made to this account...until total cash payments total $10,000 at which time this annual payment shall be cancelled."

5. Fees: No requirements.

6. Land Deeding: No specific requirements, although after site closure the state retains the right to approve all future uses of the land.

7. Land Covenants: A restrictive covenant must be issued by the permittee which specified post-closure use of the site.

8. Easements: An easement must be executed by the permittee which authorizes Department representatives to: 1) complete unfinished work on site closure plan; 2) perform work for which surety is provided; 3) sample, repair or reconstruct monitoring facilities; 4) require operator to preserve and protect monitoring facilities.

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*All quotes from: State of Kansas, Special Conditions to Permit, Department of Health and Environment, Topeka, Kansas.

FACT SHEET: Maryland

1. State of the Legislation: The Maryland Safe Disposal of Hazardous Substances Act was passed in 1976 and the regulations are expected to be promulgated soon.

2. Insurance: The permit requires that a facility maintain "adequate liability insurance." No further information was available.

3. Bonds: The state requires that an applicant either: 1) prove financial ability to operate and maintain a facility or; 2) provide a surety bond; or 3) a transfer ownership or operation to the State. The bond should be a minimum of $10,000. It provides for monitoring, maintaining, closing the facility, and for security after the closure.

4. Funds: The state established a Hazardous Substance Control Fund to provide for monitoring and controlling the "proper disposal of designated hazardous substances."* All permit fees, renewal fees and other charges are credited to this fund.

5. Fees: There is an initial application fee of $50.00. The permit fee is scaled, must be renewed yearly and is determined by: 1) the threat to the environment; 2) the cost of monitoring and regulating the site; 3) the cost of removing and disposing of hazardous substances which escape from the site; and 4) the amount of acreage of the site.

6. Land Deeding: no requirements

7. Land Covenants: no requirements

8. Access/Easement: no requirements

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*State of Maryland, Senate Bill No. 977, The Maryland Safe Disposal of Hazardous Substances Act, Section 1; Baltimore, Md., 1976.

FACT SHEET: New York

1. State of the Legislation: New York has no law which specifically addresses hazardous waste management. At this time it is incorporated into their Solid Waste Management Law and their regulations concerning waste haulers. The Solid Waste Management Division is aware that the existing laws are far too broad and a bill addressing Hazardous Waste Management is "in the works". It is unclear when it will be passed.

2. Insurance: no requirements[1]

3. Bonds: Bonds are only required upon receipt of a court order, and this is infrequent.

4. Fees: There is only a nominal registration fee.

5. Land Deeding: no requirements

6. Land Covenants: no requirements

7. Access/Easements: no requirements

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[1] An amendment to New York's Insurance Law prohibits issuance of non-accidental insurance to cover liability arising from pollution or contamination. (McKinney's Consolidated Laws of New York, Title 27 Insurance Law, §46.)

FACT SHEET: Ohio

1. State of Legislation: At this time, all hazardous waste management problems are regulated through the state's current Solid Waste Law and Regulations, enacted in 1976. The Ohio EPA has specific hazardous waste legislation due to be presented to the State Assembly in the 1977-78 session.

2. Insurance: no requirements

3. Bonds: Ohio EPA's proposed legislation requires a surety bond, the amount of which is determined per site. In considering the amount Ohio EPA considers: 1) size and type of facility; 2) quantity and composition of wastes to be stored or disposed of; and 3) "Assurances of continuity of operation consistent with the degree and duration of risk associated with the type of wastes received."*

4. Other Accounts: All fees associated with hazardous wastes, including penalties, permit, license and disposer fees, go into a rotary fund called the Hazardous Waste Collection Account. The account is administered by the Director of Ohio EPA and covers the cost of enforcing and administering the Act. It does not cover post-closure operations.

5. Fees: no information available other than the above.

6. Land Deeding: no requirements

7. Land Covenants: no requirements

8. Access/Easement: no requirements

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*State of Ohio, Propose Legislation, Section 3734.03, Ohio Environmental Protection Agency, Columbus, Ohio, 1977.

FACT SHEET: Oklahoma

1. State of the Legislation: The Oklahoma controlled Industrial Waste Disposal Act was enacted in 1976. The state Department of Health was designated as the administering agency.

2. Insurance: The state requires that the disposer have liability coverage equal to two times the value of all real property within one mile of the site (excluding the site property). This should be not less than $100,000 and not more than $500,000. Additional coverage may be required for damage to underground resources.

3. Bonds: A bond is required guaranteeing the performance of maintenance, and monitoring, and proper closure. The amount has not yet been set.

4. Fees: no requirements

5. Land Deeding: no requirements

6. Land Covenants: no requirements

7. Access/Easements: no requirements

FACT SHEET: Oregon

1. State of the Legislation: A bill concerned with hazardous waste disposal practices was passed in 1971 and revised in 1973.

2. Insurance: The Oregon law requires "adequate" liability insurance. They now require a $1 million minimum.

3. Bonds: A bond is required upon receiving a license. It begins as a surety bond of $75,000 and is gradually transformed into a cash bond by means of annual cash payments of $18,750 for the first year and $5,625/year for the next ten years. Interest credited to licensees, except for inflation deductions. The non-refundable principal and the interest covers closure, post-closure monitoring and maintenance.

4. Fee: The annual license fee of $4,324 is to cover pre-closure monitoring costs.

5. Land Deeding: All land used in hazardous waste disposal is deeded to Oregon State within 30 days of licensing.

6. Land Covenants: no requirements

7. Access/Easements: no requirements

FACT SHEET: Texas

1. State of the Legislation: The Texas Solid Waste Act of 1969 was amended in 1971 and again in 1977 to "bring it in line with Public Law 94-580."

2. Insurance: no requirements

3. Bonds: The regulations authorize the Texas Water Quality Board (the hazardous waste administering agency) to set a closure bond for a permitted site. In determining the amount, the Board receives a site's closure plans and cost estimates, and sets the bond accordingly.

4. Fees: no requirements

5. Land Deeding: no requirements

6. Land Covenants: no requirements

7. Access/Easements: no requirements

FACT SHEET: Washington

1. State of the Legislation: Washington's Hazardous Waste Disposal Law was passed in 1976, however the regulations are still in draft form.

2. Insurance: The proposed regulations require a minimum of $1,200,000 in liability insurance.

3. Bond: The proposed regulations further require that the operator post a performance bond of at least $50,000, which is refundable upon contract expiration.

4. Fees: The fee schedules will be established by the operator, subject to approval by the department. "The department shall use the following criteria to review such disposal fees: a) their relationship to other fees charged for similar services; b) reasonable return on investment and profit for the operator; and c) the cost of administration, development, operation, maintenance, and perpetual management of the disposal site."*

5. Land Deeding: The state is purchasing the land which will contain the only extremely hazardous waste facility in Washington. The operation of the site will then go out to private bid. Upon proper closure by the operator, the state immediately assumes responsibility for all subsequent monitoring and maintenance.

6. Land Covenenats: no requirements

7. Access/Easements: no requirements

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*State of Washington, Draft Regulations, July, 1977, Olympia, Washington.

FACT SHEET: Wisconsin

1. State of the Legislation: The legislation specifically concerned with hazardous waste management is still in draft form. The proposed Act is in compliance with RCRA and is expected to be enacted by next spring's session of the Assembly.

2. Insurance: no requirements

3. Bonds: no requirements

4. Funds: A Waste Management Fund will be administered by the Department of Natural Resources and supported by user fees. The general purpose of the fund is to provide for long term care. More specifically, it will provide funds for costs and expenses not anticipated in the approved plans of operation; and for the "acquisition and maintenance of facilities which the public is forced to acquire because the owner or operator either does not wish to continue being responsible for the facility, or voluntarily or involuntarily abandons the facility."[1] The fund will also be used to provide monies to repair facilities, to repair environmental damage caused by facilities, and to pay damages to persons or properties harmed by a facility.

5. Limit on Liability: The total amount of awards for any one occurrence shall not exceed $500,000.

6. Fees: The fees which represent the Fund's income will be collected quarterly on all wastes entering disposal facilities. The fees will be scaled according to the relative degree of hazard represented by each waste.

7. Land Deeding: The site operator must monitor and care for the site up to ten years after closure. At this time the state reviews the site, if "nothing is left" the state may terminate the site. If further long

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[1] State of Wisconsin, Assembly Bill 880, Prefatory Note, July 13, 1977, Madison, Wisconsin.

term care is required the site operator has two options: 1) he/she may continue to provide the necessary care and monitoring; or 2) he/she may sell the site to the state, which will then assume responsibility. In the event that the site is sold to the state, each party obtains an appraisal for the "fair market value".

8. Land Covenants: no requirements

9. Access/Easements: no requirements

APPENDIX 3

HAZARDOUS WASTE FACILITIES

INTRODUCTION

In order to assure consideration of possible contingencies which could occur in the management of hazardous wastes, a detailed review of the pertinent literature was undertaken to identify all types of hazardous waste treatment storage, and disposal facility types, all conceivable events that could occur at such facilities, and all hazardous waste types likely to be handled. After lists of facility, event, and waste types were developed, they were combined through the use of matrices to obtain all applicable facility/event/waste (FEW's) to be considered in the development of contingency plan standards. A complete discussion of the facility classification used for this analysis is presented in this Appendix.

A wide variety of facility types and disposal methods are employed by a broad spectrum of industries in the United States for the treatment, storage and disposal of waste products that are generated. Many of these wastes are considered to be "hazardous", and large quantities are generated each year.

Hazardous wastes have been defined under federal and state legislation, including the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500); Florida Resource Recovery and Management Regulations; State of California Water Resources Control Board, (subchapter 15); Illinois Pollution Control Board Rules and Regulations, (chapter 7); New York State Environmental Conservation Law (Part 360); and several other state policies, regulations or laws. An all-inclusive, comprehensive definition and classification of the term "hazardous waste" is presently being formulated and will be adopted in 1977 by EPA under RCRA (Public Law 94-580). For the preparation of this report, a general working definition of "hazardous wastes" has been defined as follows: "hazardous wastes" are wastes that are believed to potentially affect individual health or safety over the near- or long-term. Appendix 5 of this report

(Wastes) presents in detail the classification scheme adopted for this study.

A general listing of major industries which generate hazardous wastes and treat, store or dispose of these wastes on-site or through private waste management contractors includes, but is not limited to:

- organic chemicals and pesticides industries
- textiles industry
- inorganic chemicals industry
- pharmaceutical industry
- special machinery manufacturing industry
- paint and allied products industry
- leather tanning and finishing industry
- storage and primary batteries industries
- metal smelting and refining industry
- electronic components manufacturing industry
- electroplating and metal finishing industries
- petroleum refining industry
- food industry
- nuclear industry
- ordnance industry
- rubber and plastics industries

A compendium of waste management facilities owned and operated by waste generators and by private contractors was gathered through a literature search of available publications and pertinent reports and information from cognizant state and federal agencies. Several of these hazardous waste facilities have the capability of providing for effective treatment, storage or disposal of hazardous wastes, without having adverse or detrimental effects on either the natural or human environment. Only those facilities or treatment methods which would most likely be deemed suitable for the treatment, storage and disposal of hazardous wastes, as adopted pursuant to Public Law 94-580, are discussed in this report. Present disposal facilities, treatment methods, or combinations which show the most promise include but are not necessarily limited to:

Facilities:

1) landfills
2) incinerators
3) waste lagoons or ponds
4) land burial at depth
5) deep well injection
6) near-surface land burial

Final Treatment Processes:

1) oxidation/reduction
2) neutralization
3) chemical degradation
4) detoxification
5) open burning/detonation
6) hydrolysis
7) biological degradation
8) resource recovery

Preparatory Treatment Processes:

1) flocculation-sedimentation and filtration
2) precipitation
3) ammonia stripping
4) evaporation
5) centrifugation
6) carbon sorption
7) solidification/fixation
8) solvent extraction
9) vacuum distillation

Some of the aforementioned methods of treatment, particularly the preparatory treatment processes, require additional treatment and/or eventual disposal. In general, these preparatory treatment processes are utilized to reduce waste volumes or remove particular hazardous wastes (i.e., heavy metals, etc.) from the waste stream generated, and should not be considered as viable alternatives for final disposal. Therefore, only the disposal facilities and the "final" treatment processes previously listed will be discussed in detail. Alternate methods of treatment, storage or disposal will have to be evaluated on an individual basis in complying with the hazardous waste management standards to be adopted under Section 3004 of Public Law 94-580.

LANDFILLS

Standard definitions of three major types of landfills were developed by Shaver et. al. (1975), under contract by EPA which cover the types of landfill sites suitable for the disposal of hazardous wastes. The definitions of general, approved and secured landfills are as follows:

> General Landfill: A site which is limited to disposal of inert solid wastes which should not pose a threat to water quality. The site may contain water (for example, marshy areas, gravel pits, or periodically flooded areas) with no threat to water quality from the wastes.
>
> Approved Landfill: A site which is suitable for the disposal of inert solid wastes and decomposable organic materials. The site must provide separation of the wastes from underlying or adjacent usable water because of leachate possibilities.
>
> Secured Landfill: A site suitable for the disposal of all wastes, including liquid and/or solid hazardous wastes. The site must allow no discharge of these materials or their by-products to usable ground or surface waters by leaching, percolation or any other means. Another feature which may be included is inventory control on the wastes buried in the secured landfill. The prime requisite for such disposal is that the hazardous contents of the landfill be isolated from the surrounding environment. Water quality of surface and ground water must not be compromised. Air quality must also be maintained.

Typically, general landfills are not adequate for the disposal of hazardous wastes and afford no protection against leachate generation and the potential contamination of usable water resources. In addition, the potential for the generation of hazardous gases and vapors exists, which could result in fires or explosions. Although, in some instances, good site selection, design and operation could minimize these adverse effects, a general landfill should not be considered a proper facility for the disposal of hazardous wastes.

An approved landfill, where specific site conditions prevail, may be adequate for the disposal of certain hazardous waste types. In many cases, hazardous wastes could be disposed of without any additional precautions, such as steel tanks or containers. Approved landfills should have to meet the following criteria (Powers, 1976):

1) the type and quantity of each hazardous waste is known and approved for disposal by pertinent regulatory agencies;

2) the site should be environmentally suitable for hazardous wastes; and

3) provision is made for monitoring wells and leachate control and treatment if required. The necessary design standards for the disposal of hazardous wastes, which will determine if the above criteria are sufficient for the disposal of hazardous wastes, are being adopted concurrently under Public Law 94-580.

Placement in secured landfills would be the safest and most effective method for the disposal of hazardous wastes Usually, small volumes of highly toxic inorganic and organic chemicals and other extremely hazardous wastes are disposed of in this manner. Because of the hazard potential of these wastes, additional criteria to those required for an approved landfill are necessary to safeguard the environment. Examples of these criteria include: accurate recording of burial coordinates to avoid any interactions between incompatible chemicals; a water table at least 10 feet below the lowest level of the landfill; adequate provisions for the diversion and control of surface water; a vertical permeability of the natural or synthetic liner (plastic, rubber, concrete, etc.) not to exceed 10^{-7} cm/sec; and registration of the landfill site for a permanent record of its location once filled.

Although criteria for the disposal of hazardous wastes in an approved and secured landfill will vary, depending on the existing hydrologic and geologic environment, the possibilities of any damage to the environment due to toxic gas generation, leachate generation, or interactions between hazardous wastes should be minimized. Furthermore, the most environmentally favorable landfill sites should be selected for any particular hazardous waste to mitigate any possibility of adverse effects to the environment.

INCINERATORS

Incineration is a controlled process that utilizes some type of combustion/burning process to convert a waste to less bulky, less toxic, or innocuous gases, liquids and solids. Incinerators can be used to dispose of combustible solids, semi-solids and concentrated liquid wastes. In general, carbon dioxide, water and ash (of various compositions) are the major by-products of incinerator processes. When the combustion product contains undesirable compounds such as toxic hazardous waste gases (i.e. hydrogen cyanide), additional treatment such as afterburning, scrubbing, or filtration is necessary. Subsequently, the solid and liquid effluents, for example toxic inorganic oxides, if hazardous, are either treated further or disposed of at a hazardous waste facility, such as a secured landfill. In some instances, by-products, such as hydrogen chloride or lead slag, are recovered during the incineration process and recycled.

Several types of incinerators handle wastes in a more efficient manner, depending on whether the waste is in the liquid, solid or gaseous form. Some incinerators are capable of handling all three types of wastes. Examples of these incinerators, given by Powers (1976), include the fluidized bed and rotary kiln incinerators. Other incinerators that are more effective with solids and liquids are the open pit multiple chamber and multiple hearth incinerators. Liquid combustors specifically handle liquid wastes, whereas catalytic combustors, gas combustors, flares and afterburners are more suited for gaseous waste disposal. In certain cases, where the hazardous wastes themselves are not adequate as fuels to maintain combustion, additional fuels must be fed into the incinerator to support combustion.

All incineration processes create some type of secondary waste, which may be hazardous. These wastes may contain toxic gases, heavy metal sludges or organic residues. If these wastes are hazardous they must be treated, stored or disposed of at a hazardous waste facility or recycled. In general, solid and semi-solid hazardous wastes are disposed of in landfills certified to accept hazardous wastes or they are buried, sometimes in containers or tanks, by the generator in properly designed trenches or pits or transported to other hazardous waste facilities.

The major source of pollution from incinerators is the release of gaseous emmissions to the atmosphere. Depending on the type of pollutant, whether particulates or airborne gases from wastes containing halogens, sulfur or phosphorous compounds, various devices can be effectively used for pollution abatement, including cyclones, bag filters, electrostatic precipitators and scrubbers. The release of toxic gases from incinerators must be controlled by these devices to safeguard the environment.

DEEP WELL INJECTION

Several states, including Alabama, Colorado, Illinois, Indiana Kansas, Michigan, Missouri, New York, Ohio, Texas and West Virginia, have developed specific laws, regulations or policies concerning the subsurface disposal of industrial wastes. Deep well injection of hazardous wastes has become more attractive to the various process industries because of the recent enactment of federal legislation, such as the Federal Water Pollution Control Act Amendment of 1972 and the Marine Protection, Research and Sanctuaries Act of 1972, regarding the discharge of pollutants into the waters of the United States. In general, these laws focus on the potential pollution of surface waters and only indirectly address the problem of ground-water pollution. Therefore, because of the limited legal constraints presently imposed on industry, more and more hazardous wastes are being disposed of by deep well injection. Warner and Orcutt (1973) show that the number of deep injection wells in the United States has increased by a rate of 30 wells per year since 1967.

In the past, many operators minimized costs from surface discharge permits and treatment by injection of hazardous wastes into subsurface aquifers. Recent policy statements, specifically the EPA policy on subsurface emplacement of fluids by well injection, Decision Statement No. 5, are aimed at discouraging the disposal of various wastes, including hazardous wastes, to the subsurface for the purpose of avoiding discharge permits. Decision Statement No. 5 addresses, in detail, the policy requirements and guidelines that should be adhered to in order to insure protection of the subsurface environment from the emplacement of fluid wastes. EPA recognizes that deep well injection is a viable waste disposal technique provided adequate regulations and controlled conditions exist.

Subsurface disposal of liquid wastes has been practiced for many years. The mining and oil industries have used deep wells for the disposal of oil field and chemical brines. Today the major industries that dispose of hazardous wastes by deep well injection include the chemical, petrochemical and pharmaceutical industries. These industries inject solvents, corrosives, heavy metals, pesticides and other hazardous wastes, usually pretreated prior to disposal, into subsurface formations. Injection wells in the United States generally range in depth from 1,000 to over 12,000 feet (Warner 1973). Treated liquid wastes are injected by gravity flow or under pressure into subsurface strata that contain non-potable brackish or briny waters. Receiving strata must be bounded above and below by confining strata, such as clays and shales, to preclude any migration to and eventual contamination of potable water supplies. The composition of the hazardous waste is usually altered by pretreatment processes to insure that the wastes are compatible with the existing waters and subsurface environment. This process also minimizes the possibility of clogging the injection zone.

WASTE LAGOON AND PONDS

Waste lagoons and ponds have been utilized by industry for the containment and disposal of liquid wastes. The organic chemical, pesticide and tannery industries are some of the major industries that dispose of hazardous wastes in various sizes and types of lagoons and ponds (EPA, 1976f; 1976k). Depending on the volume of hazardous wastes, lagoons and ponds can consist of small concrete tanks or large excavated basins several acres in area. Typical pond sizes in the textile industry vary from one to two acres (EPA, 1976). If a natural impervious material is absent at the base of the excavation, the larger facilities must be lined with relatively impermeable natural or synthetic liners such as clay, asphalt, concrete, or plastic to prevent migration of hazardous wastes to the subsurface environment. Also, routine monitoring and detection systems usually need to be installed along with diversion structures (trenches, berms, etc.) which intercept surface water runoff from surrounding areas.

The hazardous wastes stored or disposed of in lagoons and ponds may be treated in-situ as a final disposal process and discharged; may be treated partially and disposed of at another hazardous waste disposal facility; or may be accumulated by evaporation until the volume warrants disposal at a hazardous waste disposal facility. Any combination of these methods may be employed. Some typical treatment processes include sedimentation, biochemical oxidation, and precipitation. Many times, mechanical surface aerators or sprayers are used to increase the rate of evaporation.

Ideally, lagoons and ponds should be located in geographical areas where favorable climatic conditions prevail. Such areas include those where evaporation rates are high and precipitation is minimal. Because of overflow or flooding problems in wet climates, lagoons or ponds are usually feasible only in the Western United States. In some instances, off-site disposal contractors that handle various types of hazardous wastes may find it necessary to segregate incompatible waste types or may require appropriate pretreatment by the waste generator.

Lagoons and ponds that are utilized for the temporary storage or permanent disposal of hazardous wastes should be designed and constructed to minimize any adverse environmental effects. These effects might include ground-water contamination from leachates or air pollution from the generation of toxic gases such as hydrogen cyanide.

NEAR-SURFACE LAND BURIAL

Another facility or form of hazardous waste disposal is near-surface land burial. In near-surface burial, the hazardous waste is placed directly into the ground or is deposited in stainless steel tanks, concrete lined pits or a combination of these devices (Powers, 1976). Although the hazardous wastes can be in a liquid or solid form prior to burial, the wastes are usually converted to a solid form (i.e. by cementation, solidification, etc.) to reduce the mobility of the hazardous wastes in the subsurface environment in the event of an accidental release.

Presently, near surface burial of radioactive wastes from the nuclear industry is being regulated by the Nuclear Regulatory Commission (NRC) at several sites. Hazardous chemical wastes are similarly buried in unlined trenches, up to 20 feet in depth. Morton (1968) indicates that some of these trenches are from 25 to 60 feet in width and vary from 300 to 700 feet in length. After emplacement of the hazardous wastes is completed, the trenches are backfilled to the surface with materials, such as asphalt, to reduce infiltration and leaching. Radioactive wastes are typically stored as solids or liquids in steel tanks or bins enclosed in concrete. The capacity of these tanks can exceed one million gallons.

Various types of monitoring devices are installed to detect any leaks or leaching to the subsurface environment, depending on the type of hazardous waste. Trenches are usually equipped with drains and sumps to capture any potential leakage. More stringent precautions must be taken for radioactive wastes, including instrumentation for measuring temperatures, liquid levels and possible leaks from the tanks or bins. Because of the long half-lives of several radioactive wastes, these tanks can only be considered as interim storage facilities and must be replaced or repaired if accidental releases to the subsurface environment occur.

LAND BURIAL AT DEPTH

Only limited studies have been conducted to determine the feasibility of burial of hazardous wastes, especially radioactive wastes, at depth. Bradshaw et. al. (1969) and Dunn et. al. (1971) have discussed active waste disposal in impervious salt formations. Hazardous wastes would be buried/stored at depths up to 1500 feet in unlined tunnels. After the waste disposal operation is complete, the area is sealed from the surface environment by backfilling with salt. Studies have also been performed to determine the feasibility of radioactive waste disposal in vaults excavated in deep-seated crystalline rock. These vaults can be designed to accept both liquid and solid wastes. After the vault is filled it is completely sealed off from the surface environment. Necessarily, comprehensive waste retrieval plans and monitoring systems must be devised to insure protection of the subsurface environment.

No technically acceptable concept for the ultimate disposal of radioactive wastes exists to date. Additional studies will have to be made to assess more fully the benefits and possible long-term adverse environmental effects that might result from the disposal of hazardous radioactive waste at depth. Nevertheless, non-radioactive hazardous wastes could conceivably be handled in this fashion with proper precautions.

ABOVE-SURFACE STORAGE

In some instances, hazardous waste generators might find it convenient to store extremely hazardous wastes in tanks, vaults or other containment devices on or above land surface until the wastes are collected by off-site contractors and transported to another type of hazardous waste disposal facility. Generally, the types of hazardous wastes stored in this manner are produced in small quantities. These wastes might include radioactive wastes, highly toxic organic chemicals and pesticides, or lethal gases, which may eventually be disposed of at other hazardous waste facilities, such as landfills or incinerators. Certain industries, such as the pesticides-formulating industries, use activated carbon adsorption for the removal of hazardous organic materials. The spent carbon is then stored in above surface containers until sufficient quantities are accumulated for disposal, although in some cases the carbon is regenerated by thermal methods (EPA, 1976f). Interim storage facilities of this type should provide adequate safeguards, including monitoring or leak detection systems, to prevent any accidental release of hazardous wastes to the surrounding environment. In addition, the hazardous waste storage containers should be placed in an isolated area to minimize possible detrimental effects on industrial workers.

FINAL TREATMENT PROCESSES

In this report, a "final treatment" process is defined as one which alters or destroys hazardous wastes completely, leaving only innocuous substances as by-products. Several hazardous waste generators and private contractors that dispose of hazardous wastes employ various physical and/or chemical treatment processes, in addition to storage at the aforementioned hazardous waste facilities, to effectively alter or destroy hazardous wastes. The innocuous substances that result from these processes do not, in general, have adverse effects on the environment. The wide variety of treatment processes provides a broad range of treatment capabilities for the numerous hazardous waste types generated by industry. For the most part, these processes are performed by the hazardous waste generator and often are incorporated directly into the processing plant system.

Several of the major "final treatment" processes which eliminate hazardous wastes include oxidation, reduction, neutralization, detoxification, open burning, detonation, chemical/biological degradation, hydrolysis, dechlorination, chlorination and resource recovery. Specifically, certain types of hazardous wastes (e.g., hexavalent chromium, DDT, cyanide, etc.) can be effectively destroyed or altered to a harmless state by one or more of these treatment processes.

Because hazardous wastes are generated by virtually all industries, it is advisable that the generator facilities be designed in accordance with hazardous waste disposal standards to mitigate the potential for a release to the environment. Portions of these processing areas can be considered as temporary treatment and/or storage facilities and should conform to standards promulgated under Public Law 94-580. Usually, these facilities isolate the hazardous wastes from the environment by virtue of the physical or chemical processes involved, thereby minimizing the possibility of contamination. Therefore, it is unlikely that these hazardous wastes could enter the surrounding environment, except under unusual circumstances (i.e. explosion, pipe rupture, etc.).

PREPARATORY TREATMENT PROCESSES

The preparatory treatment processes (e.g., sedimentation, flocculation, etc.) should not be construed as adequate processes for the treatment, storage or disposal of hazardous wastes. Although these processes do partially alter, accumulate or concentrate hazardous wastes, they do not, in themselves, constitute a viable means of hazardous waste treatment, storage or disposal in accordance with Public Law 94-580.

In each of these processes, additional treatment, storage or disposal at a hazardous waste facility is necessary. Therefore, these preparatory treatment processes, as well as similar processes, are not being considered as hazardous waste disposal facilities in this report.

Note: References cited in this Appendix are listed at the end of Chapter III.

APPENDIX 4

HAZARDOUS WASTE RELEASE EVENTS

The purpose of this section is to describe a classification of accidents or events whose occurrence at hazardous waste treatment, storage or disposal facilities might require emergency response measures to be undertaken. In this report, the words "accidents" and "events" are considered synonymous. Only events which relate directly to confirmed releases are considered. We have confirmed with EPA that natural disaster warnings,(e.g. for tornados and hurricanes, etc.)will be covered under operating plan requirements, to be discussed in another report.

Table 32 shows the general classes of events considered in this report. The procedure for classifying events relied primarily on a review of past incidents or releases involving hazardous wastes. In addition, a number of hypothetical events were considered to have the potential of creating emergency situations at various types of hazardous waste facilities. The

In reviewing EPA files on accidents involving hazardous wastes (EPA, 1975a; and open file materials), it is evident that in the past the majority of hazardous waste related incidents or releases resulted from the improper burial of the wastes, very often simply from depositing the wastes into open dumps, abandoned mines and pits. These improper disposal practices often resulted in ground water and surface water contamination and other serious environmental consequences (Shuster, 1976a, 1976b, 1976c). While it is assumed that the regulations to be promulgated under the provisions of RCRA will greatly reduce the incidence of improper disposal of hazardous wastes, it is felt the occurrence of any of the following events (see Table 1) at hazardous waste facilities may pose the threat of serious environmental damages unless responded to promptly and effectively:

1) Non-routine Liquid Release: Although this class covers a wide variety of situations when identified with specific facility types, rather well defined events can be related to certain facilities. At first an attempt was made to break down this class into categories according to the quantity of wastes released. However, due to the wide range of toxicity, flammability, and other characteristics among the various hazardous wastes, no such breakdown

TABLE 32

CLASSIFICATION OF EVENTS

1. Non-routine Liquid Release: seepage - surface
   - subsurface
   - failure - surface
     - subsurface
   - personnel error - surface
     - subsurface
2. Non-routine Solid Release: wind erosion
   - personnel error
3. Non-routine Gas Emission: surface
   - subsurface
4. Fire (N.F.P.A. Standard No. 10)[1]: Class A
   - Class B
   - Class C
   - Class D
5. Explosion: surface
   - subsurface
6. Dike Failure
7. Direct Human Contact
   Direct Animal Contact

---

[1] N.F.P.A. Standard No. 10 is described in Table 2.

can easily be obtained. Therefore, the releases were divided according to cause of release (i.e., event subcategories): seepage, failure, or personnel error. These three groups were then further broken down into surface and subsurface groups since detection and response for these two types of release will differ significantly. Documented cases of non-routine liquid releases include:

a) Contamination of ground water beneath the Rocky Mountain Arsenal and surrounding area (EPA, 1975b): This accident involved the contamination of a shallow water table aquifer. A complex mixture of chemical by-products was stored in a holding pond. Eventually, leachates from the pond reached the aquifer and forced the abandonment of 64 domestic, stock and irrigational wells. This event would thus be classed as a non-routine surface release as seepage.

b) Emergency Incident Involving Hazardous Wastes, Anniston, Alabama (Ghassemi, 1977): In this case, industrial wastes containing high concentrations of sulfuric acid were being stored in steel drums prior to treatment and disposal. A large number of the drums corroded during storage, and the spillage eventually contaminated both ground water and surface water. Here, the release was due to a failure at the surface.

In addition to the examples of non-routine liquid releases cited above, a large number of other non-routine liquid releases are possible at hazardous waste facilities (e.g., seepage through retention dikes, etc.). Subsurface releases can result from failure or improper installation of injection well casing, landfill liners or subsurface storage containers.

2) Non-routine Solid Release: Non-routine solid releases can occur at any hazardous waste facility that treats, stores or disposes of wastes in a solid phase, such as "dried" chemicals, explosives, sludges, etc. Typically, these releases would result from improper handling or breakage of containers used in the transport of these waste types within facility boundaries. These types of personnel errors occur frequently at hazardous waste facilities; however, the effects are generally minimized because solid wastes, unless directly introduced in surface or ground waters, tend to remain in place and do not migrate rapidly like liquid and gaseous releases. On the other hand, solid hazardous wastes can be spread over extensive areas by wind

erosion unless the waste is properly covered.

3) Non-routine Gas Emission: This class of events includes non-routine emissions from incinerators, reaction products from the improper mixing of reactive wastes (EPA, 1976a), failure of gas storage vessels, and other accidental gas releases. Non-routine gas emissions can occur in both the surface and subsurface environments depending on the facility type.

4) Fire: Fires can best be classified along the guidelines established by the National Fire Protection Association Standard Number 10 (N.F.P.A., 1976), described in Table 33 . The Standard classifies fire according to type of material burning (Class A: "ordinary combustibles"; Class B: flammable liquids; Class C: electrical equipment; and Class D: combustible metals). This classification scheme enables the immediate determination of the type of fire fighting agent to be used. An attempt was made to find a standard classification by magnitude of fire, but a review of National Fire Protection Association publication (N.F.P.A., 1976; Bahme, 1976; N.F.P.A., 1975) and interviews with local fire protection officials (Hortzell, 1977) suggest that no such classification exists.

5) Explosion: A number of explosions have been reported at hazardous waste disposal facilities, generally the result of the improper handling of wastes (EPA 1975c; 1976b; 1975d). Due to the explosive characteristics of certain wastes handled at hazardous waste facilities, there are numerous ways in which explosions can be accidentally triggered. The most convenient distinction among explosion events appears to be between surface and subsurface explosions, since the response to each type of explosion would differ significantly.

6) Dike Failure: While the class of events described by the term dike failure can likely be included in the category of non-routine liquid releases, dike failures represent a common accident of potentially serious magnitude and, therefore, merit separate consideration. Dike failure can result from either natural causes (EPA, 1975e), or improper design and construction practices (EPA, 1975b).

7) Direct Human & Animal Contact: Reports of accidental direct human and animal contact with hazardous wastes have been documented for a number of hazardous waste facilities (EPA, 1975a; 1975b; 1975c). Such

TABLE 33

N.F.P.A. STANDARD NO. 10

Class A: Fires involving ordinary combustible materials (such as wood, cloth, paper, rubber, and many plastics) requiring the heat-absorbing (cooling) effects of water, water solutions, or the coating effects of certain dry chemicals which retard combustion.

Class B: Fires involving flammable or combustible liquids, flammable gases, greases, and similar materials where extinquishment is most readily secured by excluding air (oxygen), inhibiting the release of combustible vapors, or interrupting the combustion chain reaction.

Class C: Fires involving live electrical equipment where safety to the operator requires the use of electrically nonconductive extinquishing agents. (Note: when electrical equipment is deenergized, the use of Class A or B extinquishers may be indicated).

Class D: Fires involving certain combustible metals (such as magnesium, titanium, zirconium, sodium, potassium, etc.) requiring a heat-absorbing extinquishing medium not reactive with the burning metals.

Note: References cited in this Appendix are listed at the end of Chapter III.

exposures can occur as the result of non-routine liquid and gas releases, and also in the course of routine operations. For example, a worker might accidentally step or fall into a disposal trench containing highly corrosive wastes (EPA, 1975c). The potential for contact with hazardous wastes exists at every type of facility.

APPENDIX 5

HAZARDOUS WASTES

INTRODUCTION

This section defines the hazardous waste category system developed for this study. The classification system has been devised so as to comprehensively address all conceivable waste types, i.e., it is capable of representing any type of existing or future hazardous waste stream. In addition, the classification presents the waste categories in a way which will relate meaningfully to contingency plan standards after incorporation with facility/event pairings. In the paragraphs which follow, the logic and rationale behind the development of the hazardous waste categories is outlined.

The task of defining a hazardous waste classification system is a complex one. Ideally, the results of the current EPA waste classification study would have been utilized in this investigation. Unfortunately, only preliminary thinking and effort in the classification system was available at the time required for early input in this investigation. Detailed discussions were, however, held with the Sec. 3001 Desk Officer so that the latest input would be available for this study. Nevertheless, the importance of a classification system in our study was apparent and an "interim" definition was developed.

DEFINITION

For the purposes of this report the most relevant definition of a hazardous waste is provided by the Resource Conservation and Recovery Act of 1976 (P.L. 94-580). It defines a "hazardous waste" as:

> "...a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may--
>
> "(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible, illness; or

> "(B) pose a substantial present or potential hazard to human health or the environment when improperly treated,stored, transported, or disposed of, or otherwise managed."

The term "solid waste" is defined in the Act as:

> ".... any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining and agricultural operations and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923)."

Four hazardous waste classification systems were considered and are shown in Table 34. After comparison, the "best" system was selected on the basis of relative advantages and disadvantages. Table 35 summarizes the merits of each system. From Table 35 it was decided that the fourth classification system is the most preferable system. As a result, the categories used for this report were based on the classification by associated hazards.

TABLE 34

POSSIBLE CLASSIFICATION SYSTEM BASES

I CLASSIFICATION OF WASTES BY SOURCE:

Group wastes according to the type of manufacturing process of which they were by-products. This might possibly utilize Standard Industrial Classification (SIC) codes.

II CLASSIFICATION OF WASTES BY DISPOSAL METHOD:

Group wastes according to the specific type of process used to dispose of or treat the waste.

III CLASSIFICATION OF WASTES BY CHEMICAL PROPERTIES:

Group wastes according to their specific physical or chemical properties. Under this system some typical categories would be ACID, ALKALINE, OXIDIZER, SOLUBLE, etc.

IV CLASSIFICATION OF WASTE BY ASSOCIATED HAZARD:

Group wastes according to the type of hazard the waste posed. Typical categories in such a system would be FLAMMABLE, EXPLOSIVE, CORROSIVE, etc.

TABLE 35

ADVANTAGES AND DISADVANTAGES OF CLASSIFICATION SYSTEMS

I CLASSIFICATION BY SOURCE:

ADVANTAGES:

1. SIC codes exist for a wide range of industries which are potential hazardous waste producers.

DISADVANTAGES:

1. There are a large number of waste sources. This would lead to a large number of categories.
2. It would be very difficult to consolidate categories. If one did consolidate, so many generalities would be introduced into the classification that they would not be useful.
3. Some categories are not necessarily consistent with respect to chemical, physical or hazard properties. In other words, it is not possible to characterize uniquely a source. Therefore, it would not be possible to specify standards for contingency plans which would apply to it.
4. More specific SIC categories which relate to waste types are not available.

II CLASSIFICATION BY DISPOSAL METHOD

ADVANTAGES:

1. These type classes relate directly with facility type (by definition). Thus a large number of facility/event pairings will be not-applicable. A smaller number of pairings will be less complex when related to contingency plan standards. The result will be easier to comprehend.

DISADVANTAGES:

1. The classifications for the most part do not relate to the types of hazards associated with a waste. As such, it is difficult to relate contingency plan standards to them.

TABLE 35 (cont'd)

III CLASSFICATION BY CHEMICAL PROPERTIES:

ADVANTAGES:

1. A large amount of physical and chemical property data exists for pure materials.
2. Some chemical properties relate to the hazards associated with a substance. Thus, for these categories a relationship to contingency standards can be made.

DISADVANTAGES:

1. Most wastes are not pure compounds. Although much data exists on the complex wastes, it is not necessarily applicable to waste streams.
2. Many properties do not relate to hazard categories. Therefore even if the properties were defined for a waste, the properties could in many cases not be related to specific contingency plan standards.
3. Chemical properties for the most part do not relate to "events", or "facilities".

IV CLASSIFICATION BY ASSOCIATED HAZARD:

ADVANTAGES:

1. Hazard categories, by definition, relate to the hazards associated with a waste. Therefore, these categories relate very well to contingency plan standards. This relationship is a primary objective of the classification process.
2. Hazard categories correlate well with event types.

DISADVANTAGES:

1. Hazard categories do not correlate to facilities.
2. A large number of properties fall into several areas associated with hazards. All of these must be considered simultaneously, requiring a large number of categories.
   In order to be useful, they will therefore have to be consolidated, which may introduce some undesired generalization.

CLASSIFICATION OF WASTE BY ASSOCIATED HAZARD

The hazards associated with a waste fall into five areas. For the purpose of identification these areas are denoted as; "origin of hazard", "mode of transmission", "environment of hazard", "mode of attack" and "type of hazard". Each of these areas are examined in the following paragraphs.

Origin of Hazard

The "origin of hazard" associated with a waste relates to how it becomes hazardous. For example, certain materials release or produce hydrogen cyanide gas upon combustion. The origin of hazard for such a material would be combustion. This method does not result in an exclusive classification, however. A material might also have other "origins of hazard" associated with it since there are many ways in which a material may become hazardous. The following list describes those ways which are most important.

INTRINSIC: A material may be intrinsically hazardous at standard temperature and pressure, i.e., it may not require any transformation to become hazardous. This would include a consideration of auto-degradation with time or ageing. Some materials become more dangerous with age.

REACTION WITH AIR: A material may react with air to become hazardous. For example, a substance may give off toxic fumes when it comes in contact with air. Another example is a flammable gas. When it comes into contact with air it may form a potentially explosive mixture.

REACTION WITH WATER: A material may react with water to become hazardous. For example, water reacts with calcium carbide to form flammable acetylene gas.

OTHER REACTIONS: A substance may react with other common materials to form hazards.

SYNERGISM: A substance's toxicity or other harmful effect may be activated or magnified by association with another substance. This is not a reaction but a synergistic effect.

HIGH TEMPERATURE DEGRADATION: A substance may degrade when subjected to temperatures substantially above ambient. The products of degradation may be hazardous.

EVAPORATION: A substance may volitalize or evaporate into the air. If the air mixture which results is hazardous, this category would apply.

COMBUSTION BY-PRODUCTS: The by-products of combustion may be hazardous. Commonly there may be suffocating carbon monoxide gas or cyanide gas released.

EXPLOSION BY-PRODUCTS: The by-products of an explosion may be hazardous. This situation might be due to the decomposition reaction of a chemical explosion. It could, however, also be due to an intrinsic property of a substance which was released by a rupture type of explosion.

BIO-DEGRADATION: A substance may be acted on by biological organisms. The products of this interaction may be more hazardous than the original substance.

AQUEOUS SOLUTION: A substance may be activated by going into solution in water.

Mode of Transmission

The "mode of transmission" relates to how a hazard is conveyed from its initial or safe position under controlled (preaccident) conditions to where it inflicts injury or damage. There are five modes which are important. These are explained below:

STATIONARY: A material may be hazardous in-situ. It may not require any vehicle of transmission to be hazardous. An example of such a situation is a solid high explosive.

WATERBORNE: A material may be carried via water as a solution, suspension, flotation, etc., to a distant location where it may pose a hazard. This mode implies that the material is not rendered harmless by exposure to water.

PROPELLED: A material may be carried, propelled, ejected, etc. from its "safe" location to a distant location where it might pose a hazard. An example of such a situation would be the ejection of contaminated soils or liquids from the vicinity of an explosion. Another example would be contaminated material carried from a landfill into a surrounding community by birds, rodents, etc.

SURFACE: A material may move via natural or man-made devices to a distant location where it might pose a hazard. An example would be the movement of a flammable liquid through a dry storm drain into a community.

Environment of Hazard

The "environment of hazard" is the condition under which a material is hazardous. For example, beryllium dust is toxic at very low concentrations in air, but when it is dissolved in water it poses no ingestive threat when the concentration is not too great (Battelle, 1973). Thus, an environment of hazard (with respect to toxicity) for beryllium dust would be air, but not water. The following environments are the most important ones to consider:

AIR EXPOSURE
WATER EXPOSURE
INDEPENDENT
SURFACE CONTAMINATION

Mode of Attack

The "mode of attack" refers to how a hazard affects humans. The toxic mode of attack for beryllium dust, for example, would be inhalation. The modes of attack considered in this report are:

INHALATION: A material may be hazardous if inhaled.

INGESTION: A material may be hazardous if ingested.

DERMAL PENETRATION/CONTACT: A material may be hazardous to the touch. For example, some pesticides can penetrate through the skin and produce toxic effects. Another example is a strong acid. If such a corrosive agent contacts the skin, it may produce tissue damage.

PROXIMITY: Some types of material are hazardous to humans by virtue of proximity. An explosive is a good example. If an explosion occurs it will effect humans who are near it. There is no requirement that direct contact be made with the explosive. Radioactive materials, of course, would fall into the same category.

INDIRECT: A material may be indirectly hazardous to humans by virtue of its damage potential to plants, crops, livestock, fish, etc. In addition effects on non-living objects can be considered as indirect threats to humans.

Type of Hazard

The "type of hazard" refers to the commonly recognized classes of hazard which may be presented by a material. Included in this classification are such categories as toxicity, flammability, genetic change potential, etc. It is the basic attribute system for representing a hazardous characteristic. Most of the studies which have been done in the past to define hazardous substances have used criteria which fall into this type of hazard category. Several of these studies are represented in Table 36 (EPA 1975f). It shows the criteria which were evaluated in determining what materials would be classified as hazardous. Most of these systems were developed to define hazardous substances in general; however five are concerned directly with hazardous wastes. These include Ocean Dumping - Title 40, CFR, Part 227; State of California List; Booz-Allen Applied Research, Inc.; Battelle Memorial Institute; and TRW Systems Group.

TABLE 36

SUMMARY OF CRITERIA FOR HAZARDOUS SUBSTANCE CLASSIFICATION SYSTEMS

	Criteria											
System	Toxicological	Flammability	Explosive	Corrosive	Reactivity	Oxidizing material	Radioactive	Irritant	Strong sensitizer	Bioconcentration	Carcinogenic, mutagenic, or teratogenic	Sufficient quanity
Department of the Army	X											
Department of the Navy	X	X	X	X	X	X	X					
FDA - Title 21, CFR, Part 191	X	X		X			X	X	X			X
Drinking Water Standards	X									X	X	
FWPCA - Sec. 307 (a)	X									X	X	X
FWPCA - Sec. 311	X											X
Clean Air Act - Sec. 112	X							X			X	
Ocean Dumping - Title 40, CFR, Part 227	X									X	X	X
DOT - Title 49, CFR, Parts 100-199	X	X	X	X		X	X	X				X
State of California List	X	X	X	X				X	X			
National Academy of Sciences	X	X			X							
Booz-Allen Applied Research, Inc.	X	X	X		X							X
Battelle Memorial Institute	X	X	X		X	X	X	X		X	X	
TRW Systems Group	X	X	X	X			X			X		X
NIOSH - Toxic Substances List	X										X	
Pesticides - Title 40, CFR, Part 162	X	X								X	X	

Source: State Program Implementation Guide - Hazardous Waste Surveys, USEPA, 1975.

The system which seems to have gained the most widespread use and acceptance is the 1973 Battelle Memorial Institute report Program for the Management of Hazardous Wastes, prepared for the EPA. The report developed a Hazardous Waste Decision Model which can be used to determine whether or not a given waste stream should be considered hazardous. This model is shown schematically in Figure 5-1. It provides screening criteria for hazard categories, and may serve as a working, quantitative definition of hazardous wastes.

The following abbreviated definitions are for the terms used in the model and are taken from the Environmental Protection Agency Report to Congress (EPA, 1974).

> Maximum permissible radioactive concentration (MPC) levels: Levels of radioisotopes in waste streams which if continuously maintained would result in maximum permissible doses to occupationally exposed workers and which may be regarded as indices of the radiotoxicity of the different radionuclides.
>
> Bioconcentration (bioaccumulation, biomagnification): The process by which living organisms concentrate an element or compound to levels in excess of those in the surrounding environment.
>
> National Fire Protection Association (NFPA) category 4 flammable materials: Materials including very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.
>
> NFPA category 4 reactive materials: Materials which in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.
>
> Lethal dose fifty (LD_{50}): A calculated dose of a chemical substance which is expected to kill 50 percent of a population of experimental animals exposed through a route other than respiration. Dose concentration is expressed in milligrams per kilogram of body weight.

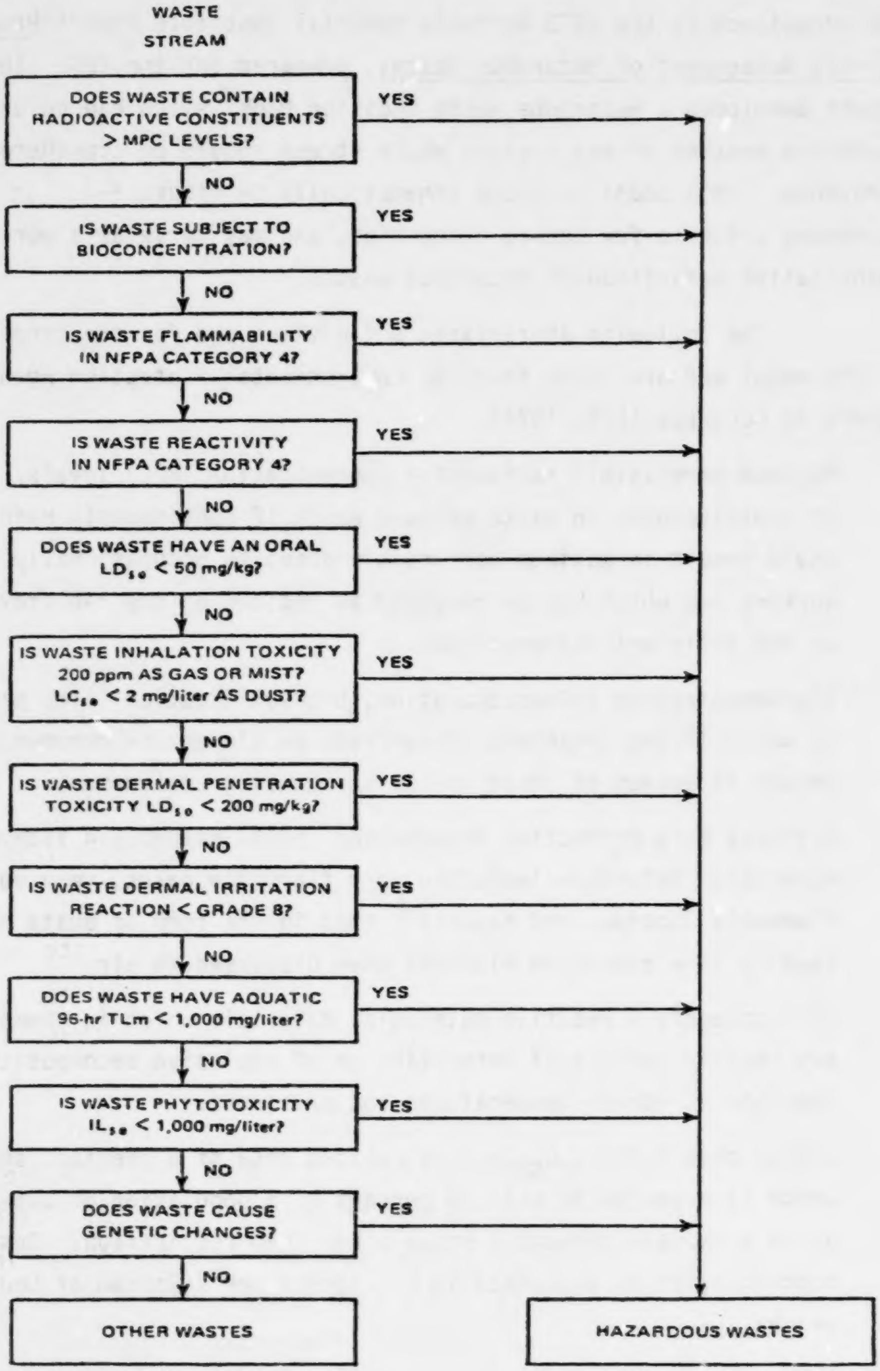

WASTE STREAM
DOES WASTE CONTAIN RADIOACTIVE CONSTITUENTS > MPC LEVELS?
IS WASTE SUBJECT TO BIOCONCENTRATION?
IS WASTE FLAMMABILITY IN NFPA CATEGORY 4?
IS WASTE REACTIVITY IN NFPA CATEGORY 4?
DOES WASTE HAVE AN ORAL LD50 < 50 mg/kg?
IS WASTE INHALATION TOXICITY 200 ppm AS GAS OR MIST? LC50 < 2 mg/liter AS DUST?
IS WASTE DERMAL PENETRATION TOXICITY LD50 < 200 mg/kg?
IS WASTE DERMAL IRRITATION REACTION < GRADE 8?
DOES WASTE HAVE AQUATIC 96-hr TLm < 1,000 mg/liter?
IS WASTE PHYTOTOXICITY IL50 < 1,000 mg/liter?
DOES WASTE CAUSE GENETIC CHANGES?
YES
NO
OTHER WASTES
HAZARDOUS WASTES

Figure 6

DECISION MODEL FOR
SCREENING AND SELECTING HAZARDOUS COMPOUNDS

SOURCE: REPORT TO CONGRESS-"DISPOSAL OF HAZARDOUS WASTES". USEPA, 1974

Lethal concentration fifty (LC_{50}): A calculated concentration which when administered by the respiratory route is expected to kill 50 percent of a population of experimental animals during an exposure of 4 hours. Ambient concentration is expressed in milligrams per liter.

Grade 8 dermal irritation: An indication of necrosis resulting from skin irritation caused by application of a 1-percent chemical solution.

Median threshold limit (96 hour TLm): That concentration of a material at which it is lethal to 50 percent of the test population over a 96-hour exposure period. Ambient concentration is expressed in milligrams per liter.

Phytotoxicity: Ability to cause poisonous or toxic reactions in plants.

Median inhibitory limit (ILm): That concentration at which a 50-percent reduction in the biomass, cell count, or photosynthetic activity of the test culture occurs compared to a control culture over a 14-day period. Ambient concentration is expressed in milligrams per liter.

Genetic changes: Molecular alterations of the deoxyribonucleic or ribonucleic acids of mitotic or meiotic cells resulting from chemicals or electro-magnetic or particulate radiation.

Screening criteria in addition to those of the Battelle model are necessary because the hazard categories used do not address all the areas which are of concern. Other sources suggesting more possibilities follow:

The office of Oil and Hazardous Materials (OHM) of EPA is responsible for handling spills and other accidents which involve oil and other hazardous substances. Their response is based on a case by case analysis of all the circumstances surrounding a particular incident. Assisting them in this capacity are a team of experts and an array of other resources. One of these important resources is a chemical information computer data base system called the Oil and Hazardous Material - Technical

Assistance Data System (OHM-TADS). The data base contains information on many aspects of hazard (EPA, 1977a). Many of the concerns are with basic physical or chemical properties of a material. A considerable number of catergories are concerned with specific, quantifiable, hazardous properties. The hazardous properties which are addressed by the system are summarized below:

CORROSIVENESS: Corrosive action to materials commonly used for packaging or equipment that might be required at a spill site.

FLAMMABILITY: Concerns the potential for flammability at a spill site. The NFPA 704 ranking system is utilized.

EXPLOSIVENESS: Concerns the potential for violent rupture or vigorous reaction at a spill site.

BIOCHEMICAL OXYGEN DEMAND: Concerns the potential to lower oxygen level in a body of water either by direction reaction with oxygen or biological oxidation. BOD is given as lb/lb or percent of theoretical demand basis.

FOOD CHAIN POTENTIAL: Indicates the potential for a material to concentrate to toxic levels while it is passed up the food chain to humans. This potential is often called bioconcentration, bioaccumulation, or biomultiplication.

ETIOLOGICAL POTENTIAL: Concerns the potential of a material to initiate or accelerate diseases or ailments by exposure.

CARCINOGENICITY: Concerns the potential of a material to produce cancer in humans.

MUTAGENICITY: Concerns the potential of a material to produce biological alterations in humans.

TERATOGENICITY: Concerns the potential of a material to produce birth defects or abnormal formations.

FRESHWATER TOXICITY: Concerns the concentration levels at which toxic effects will occur in freshwater.

CHRONIC AQUATIC TOXICITY: Concerns the chronic long-term exposure limits of fish for a substance.

SALT WATER TOXICITY: Concerns the toxicity levels of estuarine or marine animals for a substance.

ANIMAL TOXICITY: Concerns the toxicity levels of various test animals for a substance.

CHRONIC ANIMAL TOXICITY: Concerns the chronic or long-term toxicity levels of animals for a substance.

LIVESTOCK TOXICITY: Concerns the toxicity level of a substance toward livestock.

HAZARD TO WATERFOWL: Concerns the effects of a substance on waterfowl. Relates to the acute exposure limits.

CHRONIC HAZARD TO WATERFOWL: Concerns the chronic or long-term effects of a substance on waterfowl.

AQUATIC PLANT TOXICITY: Concerns the potential of a substance to injure aquatic flora.

IRRIGABLE PLANT TOXIC: Concerns the potential of a substance to be injurious to crops.

CHRONIC PLANT TOXIC: Concerns the potential for injury to crops which are exposed chronically or on a long-term basis to irrigation water contaminated with a substance.

TASTE IMPARTING CHARACTERISTICS: Concerns the potential for a substance to impart an undesirable taste to the flesh of fish living in affected waters.

INHALATION LIMIT: Concerns the inhalation toxicity levels of a substance.

IRRITATION LIMIT: Concerns the concentration levels required for a material to cause irritation to the skin and mucous membranes of the body.

DIRECT CONTACT: Concerns the potential of a material to be irritating or corrosive on direct contact with the skin, eyes or mucous membranes.

DIRECT HUMAN INGESTION: Concerns the potential of a substance to be toxic if ingested directly.

DRINKING WATER LIMITS: Concerns the levels which are recommended as being safe in drinking water.

BODY CONTACT EXPOSURE: Concerns itself with the acute contact hazard of a substance in water.

PROLONGED HUMAN CONTACT: Concerns itself with the safe levels in water which is used for prolonged bathing and swimming activities.

INDUSTRIAL FOULING POTENTIAL: Concerns the potential for water contaminated with the substance in question to cause problems when used by industry. This relates to scale forming agents as well as materials with potential rupture hazards when included in boiler feed or cooling water.

EFFECT OF WATER TREATMENT PROCESSES: Concerns the potential interactions with typical water and waste water treatment facilities. This includes the effect of chlorination an aesthetic properties of contaminated water, as well as the effect of high concentration on sewage organisms.

The above categories can be divided into two areas of emphasis; short-term, immediate, acute effects; and long-term, future, chronic effects. Each category has a difference in the degree of concern which is associated with it. In relation to accidents, the factor of environmental persistance (non-biodegradability) plays a vital role in deciding what should be considered as important. If a substance is chronically toxic to fish, but is not persistent in the environment, then it would not be an important hazard to consider. Using this rationale, the distinction between chronic and acute in the OHM-TADS classification may be disregarded and categories lumped together. This procedure was adopted in integrating and converting the OHM-TADS concern categories into the general type of hazard categories used in this report. The categories which result from this summarizing are listed below:

TOXIC
IRRITATING
SENSITIZING
CARCINOGENIC
TERATOGENIC
ETIOLOGIC
INFECTIOUS
RADIOLOGICAL
EXPLOSIVE
FLAMMABLE
BIOCONCENTRATING
BIOCHEMICAL OXYGEN DEMANDING
AQUATIC TOXIC
PHYTOTOXIC
IRRIGABLE PLANT TOXIC
AQUATIC PLANT TOXIC
ANIMAL TOXIC
CORROSIVE TO EQUIPMENT, ETC.
INDUSTRIAL FOULING
WATER TREATMENT FOULING

All five of the major areas which have been discussed must be considered simultaneously to completely describe a hazardous waste in relation to an accident situation; however, it is awkward to do this inasmuch as a total of 25,200 possible combinations result. Obviously, the categories need to be combined and grouped into a more workable number. To accomplish this a systematic approach was taken. Each of the areas; "type of hazard", "mode of attack", "mode of transmission" and "environment of hazard" but not "origin of hazard" were integrated with one another in successive steps. The integrations were done to show which attributes in each area were not compatable. For example, consider the ingetration of the "type of hazard" with the "mode of attack":

> The "type of hazard" category called EXPLOSIVE is not applicable to the "mode of attack" category INHALATION. This is because inhalation is not a a mode of attack for an explosive material. On the other hand the "mode of attack" categories of PROXIMITY and INDIRECT are applicable to an explosive substance.

Once the applicability between the categories was established, some of them were combined into hybrid groups. For this reason the integration processes were denoted as "hybrid integrations". The hybrid categories which resulted from the first integrations were included in the next integration and so on until a final set of hybrid categories evolved.

The "origin of hazard" categories were combined with the final hybrid categories in a different way than above. The "origin of hazard" categories were first clustered into "event" related groups, as described below. The reason for this will be made apparent later. The resulting "event" groups were then integrated with the final hybrid categories to produce the final waste categories. This integration and clustering process is shown schematically in Figure 5-2.

A first step in this direction is taken by integrating the "type of hazard" with the "mode of attack" categories. This integration is shown schematically in Figure 5-3. Coming out of the process are nine groups which are numbered one through nine in the table. For identification purposes these groups are denoted as follows:

GROUP 1 - INHALATION HEALTH HAZARD
GROUP 2 - INGESTION HEALTH HAZARD
GROUP 3 - CONTACT HEALTH HAZARD
GROUP 4 - RADIOLOGICAL
GROUP 5 - EXPLOSIVE
GROUP 6 - FLAMMABLE
GROUP 7 - BIOCONCENTRATIVE
GROUP 8 - ENVIRONMENTAL HAZARD
GROUP 9 - CORROSIVE/FOULING

The second step toward consolidation of categories involves integration of the "type of hazard" - "mode of attack" hybrid categories with the "mode of transmission" category. This is shown in Figure 5-4. There are ten groupings which result. They are numbered in the table and identified below:

GROUP 1 - AIRBORNE HEALTH HAZARD
GROUP 2 - WATERBORNE HEALTH HAZARD

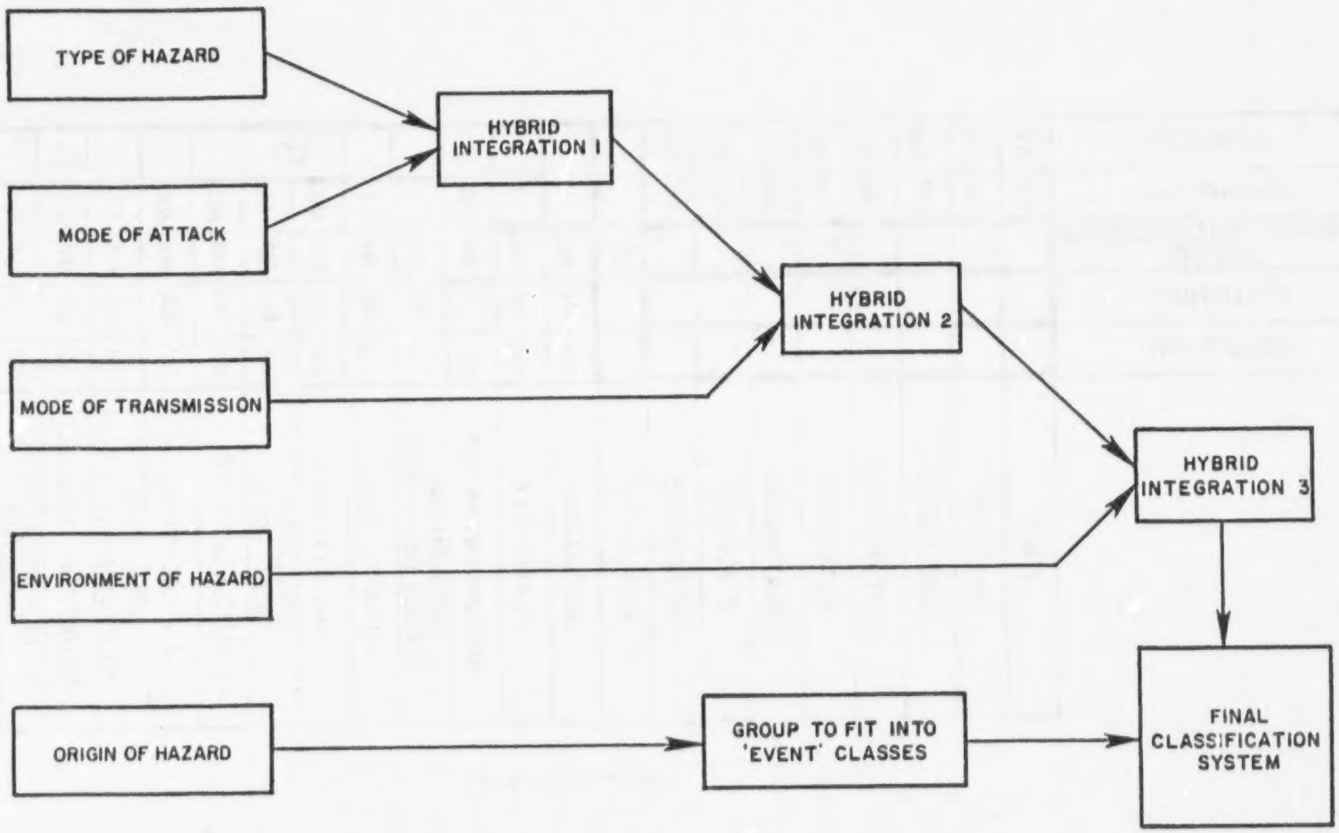


Figure 7

FLOW DIAGRAM:
EVOLUTION OF WASTE CATEGORIES

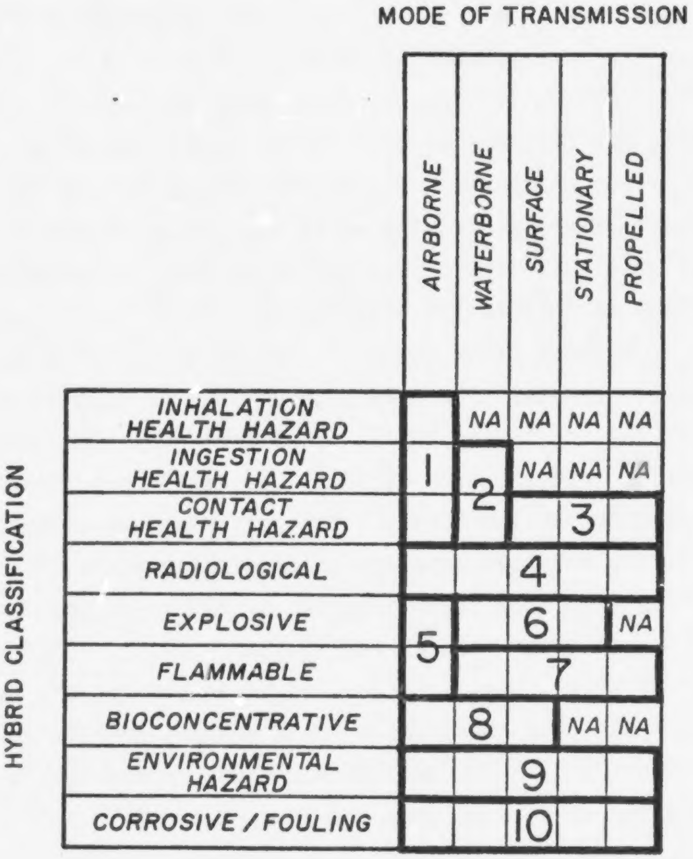
Figure 8

FIRST HYBRID INTEGRATION

TYPE OF HAZARD	MODE OF ATTACK				
	INHALATION	INGESTION	DIRECT PENETRATION/CONTACT	PROXIMITY	INDIRECT
TOXIC	1	2	3	NA	NA
IRRITATING				NA	NA
SENSITIZING				NA	NA
CARCINOGENIC				NA	NA
MUTAGENIC				NA	NA
TERATOGENIC				NA	NA
ETIOLOGIC				NA	NA
INFECTIOUS				NA	NA
RADIOLOGIC	4				
EXPLOSIVE	NA	NA	NA	5	
FLAMMABLE	NA	NA	NA	6	
BIOCONCENTRATING	NA	7	NA	NA	NA
BIOCHEMICAL OXYGEN DEMANDING	NA	NA	NA	NA	8
AQUATIC TOXIC	NA	NA	NA	NA	
PHYTOTOXIC	NA	NA	NA	NA	
IRRIGABLE PLANT TOXIC	NA	NA	NA	NA	
AQUATIC PLANT TOXIC	NA	NA	NA	NA	
ANIMAL TOXIC	NA	NA	NA	NA	
CORROSIVE TO EQUIPMENT, ETC.	NA	NA	NA	NA	9
INDUSTRIAL FOULING	NA	NA	NA	NA	
WATER TREATMENT FOULING	NA	NA	NA	NA	

Figure 9

SECOND HYBRID INTEGRATION



MODE OF TRANSMISSION

HYBRID CLASSIFICATION	AIRBORNE	WATERBORNE	SURFACE	STATIONARY	PROPELLED
INHALATION HEALTH HAZARD		NA	NA	NA	NA
INGESTION HEALTH HAZARD	1	2	NA	NA	NA
CONTACT HEALTH HAZARD				3	
RADIOLOGICAL			4		
EXPLOSIVE	5		6		NA
FLAMMABLE				7	
BIOCONCENTRATIVE		8		NA	NA
ENVIRONMENTAL HAZARD			9		
CORROSIVE / FOULING			10		

GROUP 3 - CONTACT HEALTH HAZARD
GROUP 4 - RADIOLOGICAL
GROUP 5 - FLAMMABLE/EXPLOSIVE VAPOR
GROUP 6 - EXPLOSIVE SOLID/LIQUID/SOLUTION
GROUP 7 - FLAMMABLE SOLID/LIQUID/SOLUTION
GROUP 8 - BIOCONCENTRATIVE
GROUP 9 - ENVIRONMENTAL HAZARD
GROUP 10 - CORROSIVE/FOULING

To combine the categories still further a third hybrid integration is performed. This one involves the categories from the previous step and the "environment of hazard" classification. Figure 5-5 shows the results. Notice that no vertical consolidation has taken place. Therefore, the original classification names (above) are retained for each of the groups which are numbered one through ten in the table. There remains one further integration which must be performed to arrive at the final set of classification which will be used to characterize a waste hazard. This is integration with the "origin of hazard". Examination of the "origins of hazards" list suggests a possible way of grouping which will relate to events. The advantage of this is that it will eliminate a great deal of redundancy in classification. Consider the following example: Suppose that a material had toxic combustion products. An origin of hazard for this material's toxicity would be combustion. Suppose also that the material were not intrinsically toxic. If the material were classified in a fully expanded system (i.e. one which, for example, included categories such as INTRINSICALLY TOXIC, TOXIC WHEN COMBUSTED, TOXIC IN WATER, etc.) there would be an unnecessary redundancy of notation. When facility/event/waste groupings are correlated the waste column called TOXIC WHEN COMBUSTED would be non-applicable in all those cases where the event FIRE were not present.

Several categories are listed below. Each category is composed of one or more of the original "origin of hazard classes. Where possible, the groups relate to facility/event types.

I. SURFACE LIQUID RELEASE
    A. INTRINSIC

Figure 10

THIRD HYBRID INTEGRATION

HYBRID CLASSIFICATION	ENVIRONMENT OF HAZARD			
	INDEPENDENT	AIR EXPOSURE	WATER EXPOSURE	SURFACE CONTAMINATION
AIRBORNE HEALTH HAZARD	NA		1	
WATERBORNE HEALTH HAZARD	NA		2	
CONTACT HEALTH HAZARD		3		
RADIOLOGICAL		4		
FLAMMABLE/EXPLOSIVE VAPOR	NA	5	NA	NA
EXPLOSIVE SOLID OR LIQUID		6		NA
FLAMMABLE SOLID OR LIQUID		7		NA
BIOCONCENTRATING	NA	NA	8	
ENVIRONMENTAL HAZARD		9		
CORROSIVE/FOULING	NA		10	

- B. REACTION WITH AIR
- C. REACTION WITH WATER
- D. AQUEOUS SOLUTION
- E. BIODEGRADATION
- F. EVAPORATION

II. SURFACE SOLID RELEASE
- A. INTRINSIC
- B. REACTION WITH AIR
- C. EVAPORATION

III. FIRE
- A. INTRINSIC
- B. HIGH TEMPERATURE DEGRADATION
- C. EVAPORATION
- D. COMBUSTION BY-PRODUCTS
- E. REACTION WITH WATER
- F. AQUEOUS SOLUTION
- G. BIODEGRADATION

IV. EXPLOSION
- A. INTRINSIC
- B. EXPLOSION BY-PRODUCTS

V. DIRECT CONTACT
- A. INTRINSIC

VI. GASEOUS SURFACE RELEASE
- A. INTRINSIC
- B. REACTION WITH AIR

VII. GASEOUS/LIQUID SUBSURFACE RELEASE
- A. INTRINSIC
- B. REACTION WITH WATER
- C. AQUEOUS SOLUTION
- D. BIODEGRADATION

VIII. REACTIVITY
- A. REACTION WITH WATER
- B. REACTION WITH AIR

C. OTHER REACTION
D. SYNERGISM

Special attention is given to the last category; REACTIVITY. It is the only one which does not relate to specific event types. Therefore, this category was added to the hybrid "type of hazard" - "mode of attack" - "mode of transmission" categories. Note that it contains the"origin of hazard" class SYNERGISM. Synergism is the joint action of two or more agents which act together to produce an effect which is more pronounced than the effect of any of the agents acting alone. A synergistic interaction involving two chemicals is not a reaction per se. It is however, consistent with the definition of Reactivity. For this reason, it was included in the REACTIVITY grouping. One final grouping is added to deal with the case where a material's identity or properties are not known. This category is called UNKNOWN.

The final waste hazard categories are therefore as follows:

I. AIRBORNE HEALTH HAZARD
II. WATERBORNE HEALTH HAZARD
III. CONTACT HEALTH HAZARD
IV. RADIOLOGICAL
V. FLAMMABLE/EXPLOSIVE VAPOR
VI. EXPLOSIVE SOLID/LIQUID/SOLUTION
VII. FLAMMABLE SOLID/LIQUID/SOLUTION
VIII. BIOCONCENTRATIVE
IX. ENVIRONMENTAL HAZARD
X. CORROSIVE/FOULING
XI. REACTIVE
XII. UNKNOWN

These may be summarized as follows:

FLAMMABLE/EXPLOSIVE VAPOR:

This category is reserved for gases and vapors which are flammable and/or explosive. In addition, it is applicable to liquids (or solids) which are extremely volatile and give off flammable/explosive vapors.

FLAMMABLE SOLIDS/LIQUIDS:

This category is reserved for liquids, solids, sludges, slurries, etc. which are flammable.

EXPLOSIVE SOLIDS/LIQUIDS:

This category is reserved for solids, liquids, sludges, slurries, encapsuled or contained gases, liquids, etc. which may present an explosion hazard.

BIOCONCENTRATIVES:

This category is reserved for substances which may concentrate in a single species or through a series of species (plant or animal) in the human food chain to a level, above the ambient level, which are toxic or injurious to humans.

CORROSIVES:

This category is reserved for substances which are corrosive to equipment, structure, containers, etc. which are likley to be found in hazardous waste facilities or which may be used at such facilities during emergencies.

REACTIVES:

This category is reserved for substances which tend to react spontaneously in a hazardous way with common materials. Included in this category are substances which may undergo synergistic interactions. In this definition the term "hazardous way" means that the substance may react so as to produce any of the following effects:

a. violent reaction (spewing reactants)
b. rapid heat generation
c. generation of hazardous products

The term "common material" would include:

a. air
b. water
c. structural metals
d. other construction materials

RADIOLOGICAL:

This category is reserved for materials which spontaneously emit ionizing radiation to the environment. This includes radionuclides and materials contaminated with radionuclides. It does not include materials covered by NRC regulations.

ENVIRONMENTAL HAZARD:

This category is reserved for substances which pose a threat to the environment. This would not include the hazards of fire, explosion or radiological materials, nor would substances producing adverse effects on humans alone be classified as ENVIRONMENTAL hazards. The emphasis is on effects on plants, crops, fish, shellfish, livestock, etc.

In addition, materials which might effect the structure, function, etc., of non-living objects in such a way that it may cause harm to plants, animals, or humans would be classified as an ENVIRONMENTAL hazard.

AIRBORNE HEALTH HAZARD:

This category is reserved for substances which may be transported via the air and which pose a health hazard to humans. This health hazard would not include the normal hazards associated with fires, explosion or radioactive materials. Hazards that would be included are:

a. inhalation toxic
b. dermal penetration toxic
c. irritating
d. sensitizing
e. etiologic
f. carcinogenic
g. mutagenic, teratogenic, etc.
h. ingestion toxic (applies to material which might settle on the surface of plants which are subsequently eaten).

WATERBORNE HEALTH HAZARD:

This category is reserved for substances which may be transported via water as a solution, suspension, or flotation and which pose a health hazard to humans. This health hazard would not include the normal hazards associated with fires, explosions or radiological materials. Hazards which would be included are:

a. ingestion toxic
b. dermal penetration toxic
c. irritating
d. sensitizing
e. etiologic
f. carcinogenic
g. mutagenic, teratogenic, etc.

CONTACT HEALTH HAZARD:

This category is reserved for substances which may be transported via direct contact and which pose a hazard to human health. The direct contact might be via fallout from an explosion, splash from or contact with a spill, or mishandling of materials. The normal hazardous effect associated with fires, explosions, or radiological materials are not considered under this category.

Hazards which would be included are:

a. dermal penetration toxic
b. irritating
c. sensitizing
d. etiologic
e. carcinogenic
f. mutagenic, teratogenic, etc.

UNKNOWN:

This category is reserved for materials whose compositions or properties are unknown. An example of an UNKNOWN hazard would be an unlabeled (perhaps due to corrosion or negligence on the part of an operator) drum of material which is in close proximity to a fire at some type of facility.

As previously mentioned, the EPA has not promulgated regulations defining what the hazard categories are or what degree of danger is necessary before a substance can be called hazardous. This contract study is currently in progress and when it is finished, it should provide the best basis for threshold values. Until threshold values are finalized in that study, it is best to speak in qualitative terms only.

Note: References cited in this Appendix are listed at the end of Chapter III.

APPENDIX 6

DAMAGE SCENARIOS; INTRODUCTION

These damage scenarios were designed as a conceptual aid to focus attention on liability limits that may result from hazardous waste damage events. To date, there is not a compilation of damages that resulted from events at hazardous waste management facilities. Documented cases are largely limited to accounts of accidents, spills and leaks from various industries other than the disposal industry. Furthermore, these accounts do not cover the full range of potential damages.

Hazardous waste incidents on the scale of the mercury poisoning cases in Japan or the dioxin disaster in Italy have not occurred in the United States. Thus, to accurately reflect the true nature of the problem, these damage scenarios were designed. They are based on actual incidents that have occurred or are extensions of such incidents. While in a few technical areas, they may prove to be inaccurate, such inaccuracy will not detract from their overall utility in highlighting both potential damages and the consequences of these damages.

Incinerator Malfunctions

- Operating Characteristics

-An incinerator used to dispose of hazardous wastes has the following operating characteristics:

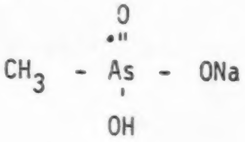
10 GPM Waste Tar
13,000 FT^3/MIN Combustion Air
20,000 FT^3/MIN TEMPERING AIR
300 GPM Fresh Water
2,300 GPM Recycled Water

- Failure Mode

-One hour undetected interruption in recycled water flow permitting flue gas exit with insufficient scrubbing - 2:30-3:30 PM .

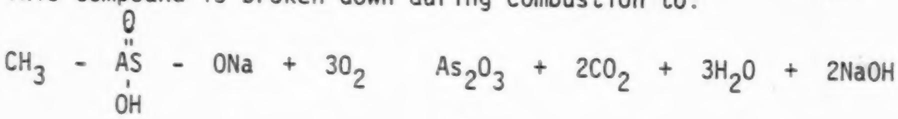
At that time, one-third of tar content is:

MSMA:



$CH_3 - \overset{O}{\underset{OH}{As}} - ONa$

This compound is broken down during combustion to:



$$CH_3 - \overset{O}{\underset{OH}{AS}} - ONa + 3O_2 \quad As_2O_3 + 2CO_2 + 3H_2O + 2NaOH$$

Based on air flow and full release of As_2O_3, the concentration at the stack is 1,118 PPM

- Dispersion

-Assume westerly winds at 5 MPG during period of release. The area of exposure is 2,356 SQ. MI.

- Receptor Interaction

  -Small town of 500 families located 40 MI. down wind. 20 families located at closer distances 2,000 head of cattle located within 10 miles

- Ecological Impact

  -In town: Skin Effects - Hyperkeratosis of palms and soles; Edema of Eyelids - 20 people - duration 2 months

  -Closer families: Central Nervous System-Mental Confusion, Defective Control of Muscles-10 People; Skin Effects-20 People- Duration 6 Months

  -Cattle: Nausea, Vomiting, Contaminated Milk-10 Cattle Die-Duration 3 Months

- Financial Impact

  -Action for damages suits result in the following rewards:

  Skin Effects - $50,000
  Nervous System - $1,200,000
  Cattle - $10,000
  Total - $1,260,000

Secure Landfill

Class I Secure Landfill Disposing Petroleum Refinery Hazardous Materials On Site

- Operating Characteristics
  - Segregation of Wastes
  - Neutralization of Acids and Caustics
  - Reduced Fluid Mobility Through Suitable Soil Mixture
  - Daily Earth Covering of 6" Soil

- Failure Mode
  - Explosion and Subsequent Fire Caused by Unknown, Unanticipated Chemical Reaction
  - Toxic Cloud Includes Oily Wastes, Phenols and Some Tetraethyl Lead Vapors Toxic At .075 - .15 MG/M^3

- Dispersion
  - Explosion Radius 115' ∴ Contained Within Site 10 MPH Wind
  - Fire Lasts 2 Hours But Evacuation Successful After 1 Hour

  Area of Exposure 10 Sq. Mi.

- Receptor Interaction
  - Urban Area of 500 People/Sq. Mi. ∴ Total Exposed Population = approximately 5000 People.

- Ecological Impact
  - Approximately 1000 people experience irritation including skin and lung problems. 45 people receive superficial skin burns from exposure to airborne toxics, 17 people experience nausea and vomiting, 5 experience recurring headache and dizziness over 3 month period. One elderly man is killed by a stroke during the evacuation procedures.

- Financial Impact

  -Since many of the exposed people are employing in the local petrochemical industry only a small number file actions for damages against the refinery. Eight of the 62 people who recovered within 36 hours sued for a total of $100,000. Three of the recurring cases sue for $200,000 each and the widow of the stroke victim sues for 2 million dollars. To avoid negative publicity and although they are self-insured and deny liability, the refinery makes a guick out of court settlement for $150,000.

Explosion at Secure Landfill

- Operating Characteristics
  - Segregation of Wastes
  - Neutralization of Acids and Caustics
  - Reduced Fluid Mobility through Suitable Soil Mixture
  - Daily Earth Covering of 6" Soil

- Failure Mode
  - During the compacting process a small explosion occurs that ruptures a nearby large pesticide temporary storage tank. A cloud of dioxin is released.

- Dispersion
  - Wind velocity is 3 MPH. The site is located in a bowl shaped valley and there the cloud hovers over the valley for 36 hours.

- Receptor Interaction
  - Alert to the experience in Italy evacuation procedures are triggered immediately. 8000 people are evacuated. Livestock herds totalling 2,500 animals are left behind.

- Ecological Impact
  - Dioxin is one of the most toxic chemicals known. Based on animal studies, both the oral and dermal lethal doses are in the range of micrograms per kilogram body weight.

- Liability Assessment
  - 5000 people are allowed to return to their homes. The other 3000 are unable to return until the contamination level is reduced. The National Guard seals off the contaminated areas. All drinking water in the valley is contaminated and thus bottled water must be provided. All livestock is condemned and destroyed. Because of the prompt evacuation procedures, only 75 people in the immediate area of the site

are exposed. Law suits totalling 200 million dollars are filed against the facility by the 3000 dispossessed , the 75 people directly affected, the owners of the livestock, and the city government. The breakdown of this sum is as follows:

75 injured total	$120 million
2000 dispossessed total	70 million
livestock total	8 million
city government	2 million

The courts award settlements totalling $38 million.

Earthquake at Secure Landfill

- Operating Characteristics
  - Segregation of Wastes
  - Neutralization of Acids and Caustics
  - Reduced Fluid Mobility Through Suitable Soil Mixture
  - Daily Earth Covering of 6" Soil

- Failure Mode
  - Mild earth tremor cracks liner at bottom of landfill allowing contact with groundwater. Tremor occurs at night and is not noted by site operators.

- Dispersion
  - The slow leak of heavy metals including mercury and chromium into an adjacent aquifer continues for fifteen years before it is detected. 58 private wells draw upon this aquifer for water supply as well as one poultry processing plant.

- Receptor Interaction
  - 250 individuals are effected having consummed contaminated water for an estimated 5-7 years. No pass on of heavy metals is thought to have occured in the poultry plant.

- Ecological Impact
  - 10 individuals are found to have mild nose and throat problems, six more severe liver damage and one severe central nervous system damage attributed to mercury poisoning.

- Financial Impact

-A recovery of costs damage suit for $10,000 is filed by the poultry plant for installation of filter equipment. The 10 least affected individuals file suit for $100,000 each, the six more severe cases, $100,000 each, and the most severe case sues for 1 million dollars. The municipality sues for $500,000 for cost of supplying an alternative water supply to the area. The court awards a total of 1.1 million dollars.

Slow Leak at Secure Landfill

- Operating Characteristics
  - Segregation of Wastes
  - Neutralization of Acids and Caustics
  - Reduced Fluid Mobility Through Suitable Soil Mixture
  - Daily Earth Covering of 6" Soil

- Failure Mode
  - The landfill is located above a dry aquifer. It is determined the aquifer has been dry since a nearby large river naturally changed its course 200 years ago. Development activities in the area including the construction of a dam and canal, the blacktopping of natural recharge sites, and large scale irrigation alters ground water channels and refills the aquifer. Slow erosion underneath the landfill allows infiltration of chemicals including potassium cyanide.

- Dispersion
  - The potassium cyanide infiltrates the regional reservoir that provides the drinking water for 120,000 people as well as into 200 private drinking wells.

- Receptor Interaction
  - Although monitors at the reservoir detect the potassium cyanide before the water is utilized by the public, numerous private well users are poisoned.

- Ecological Impact
  - Potassium Cyanide is a very toxic chemical. 170 families are poisoned by drinking from their private wells. 18 deaths result (primarily very young and very old people) and 60 people are hospitalized for severe poisoning. 27 of these patients develop permanent damage.

- Liability Assessment

-17 of the 18 deaths result in law suits as do all 27 of the permanently impaired and 120 people who were seriously exposed. Suits totalling $134 million are filed. They include:

17 deaths total	$ 34 million
27 permanently impaired total	75 million
120 seriously exposed total	25 million

The courts award settlements totalling $40 million.

Tornado at Solvent Reclaiming Plant

- Operating Characteristics
  - A small solvent reclaiming plant operates batch reclaiming operations. The toxic residue from the reclaiming process is stored in barrels in an on-site warehouse until sufficient quantities are accumulated to justify contracting an independent disposer to haul the barrels to a secure landfill. The independent disposer arrives about twice yearly.

- Failure Mode
  - A tornado sweeps through the reclaiming site destroying 70% of the reclaiming plant and the entire storage warehouse.

- Dispersion
  - Two types of hazardous wastes are dispersed into the environment; solvents prepared for the reclaiming process such as carbon tetra chloride and methyl chloroform, and toxic residue resulting from the reclaiming process. Within 300 yards of the site, 186 barrels are scattered along the path of the tornado. Most are ruptured and leaking. Located over a 2 sq. mile path are additional barrels in indeterminate numbers.

- Receptor Interaction
  - On 3 private properties near the plant leaking barrels are located. The occupants are evacuated. Over a weeks time, the barrels scattered over the 2 sq. mile area are located and returned. However, 10 days after the storm, 5 small children are playing in a wooded area and discover one of the barrels. Attempting to role the barrel downhill the barrel leaks and fumes overcome one of the children and temporarily blind two others. Another individual finds one of the barrels, takes it home and tries to fabricate a home fireplace. The fumes send this individual to the hospital.

- Ecological Impact
  - -The duration of the exposure is brief and then only the short range effects of cramps, vomiting and temporary coma are experienced.

- Financial Impact
  - -The four individuals bring actions for damages totalling $80,000 and receive a settlement of $5,000 each.

Concrete Encapsulation of PCB Residue

•Operating Characteristics

-A chemical treatment facility disposes of large quantities of PCB residue by encapsulating the PCB in concrete and storing the concrete on site. These blocks are confused with a recent shipment of concrete to be used for an on-site construction project. The on-site construction is cancelled and the concrete sold. A highway construction firm purchases the concrete to use as road base for a new 15 mile section of superhighway without knowing about the PCB content. After one year of grading and laying the highway base, the project meets local opposition as citizens attempt to have the highway built elsewhere. After two years of court proceedings, the project is abandoned after sealing the road base with asphalt.

•Failure Mode

-Ten years later, a housing development is built amidst the abandoned highway. The broken up road bed rubble is hauled 3/4 of a mile away and used to fill a wetland area and flood plain. Over a fifteen year period the PCB's slowly leach into a tidal river.

•Dispersion

-The PCB percipitates into the bottom silt over a 7 mile length of river.

•Receptor Interaction

-No humans are directly affected but fish in the area start showing large quantities of PCB's in their tissue forcing the shutdown of a small, thriving fishing industry.

•Ecological Impact

-Fish and benthic organisms absorb the PCB's and pass them along the food chain.

- Financial Impact
  - The original disposer, a large and financially secure organization, is still in business. They are sued for damages resulting in loss of revenue by the local fisherman for 8 million dollars and in an out of court settlement pay 1.5 million dollars.

Land Spreading on Contract Basis of Industrial Wastes

- Operating Characteristics
  - small land spreading and landfill company operating 4 trucks on contract basis servicing industries in 50 mile area
  - oily wastes are land spread on cropland and sprayed on roads as dust control agent
  - included in customer list is a chemical company that also produces insecticides and weed killers
- Failure Mode
  - barrels containing arsenic residue (AS_2O_3) from the insecticide plant are accidently included with the oily waste barrels and instead of landfilled are used for landspreading
- Dispersion
  - the arsenic is sprayed as a dust control agent at a local fairground's horse arena
- Receptor Interaction
  - 15 people, including seven children and four fairground employees, are adversely affected by exposure to the dust
- Ecological Impact
  - severe skin, central nervous system and gastro-intestinal effects of 3 days to 9 months duration
- Financial Impact
  - various actions for damages totalling 1.5 million dollars are filed against to disposer who is unable to pay the damage suits and is forced to sell its assets and declare bankruptcy.

APPENDIX 7

CONTENTS OF TRAINING MODULES

TRAINING MODULE 1

Title: The Problem of Hazardous Wastes and Their Control

Objective: To provide a general orientation and understanding of the world of hazardous wastes.

Theme: Hazardous wastes are a new problem area. If not controlled they are a threat to the public health and welfare. Their control must be by the mechanism of regulation (which internalizes the problem to the producing industry).

Time: 5-20 minutes per subject

Format: Video tape with self teaching exams. In-depth supplement for Professional and Class A certifications require reading of selected references, including PL 94-580; self teaching examinations are included. Completion of self teaching examinations may satisfy Module 1 certification requirement.

Subject	Content
Definition of Hazardous Wastes	. EPA definition hazardous wastes . Categories of hazardous wastes
Legal Mandates	. PL 94-580, objectives and key provisions . Permit Program . EPA Guidelines . Other related federal legislation . State legislation
Extent of the Hazardous Waste Problem	. Sources . Current transport and disposal . Practices . Incidents . Consequences of lack of proper control
Importance of Proper Handling and Disposal	. Worker health and safety . OSHA requirements . Community health and safety . Environmental hazards
References	. PL 94-580 . Other laws . Regulations . Reports and manuals

TRAINING MODULE 2

Title: Practices Required in Processing Hazardous Wastes

Objective: To provide an understanding of the elements of practice for a hazardous waste processing facility.

Theme: Hazardous wastes may be explosive, flammable, toxic, etc. Handling these substances requires special procedures and caution, to insure both the health and safety of the workers and the community and to minimize potential harm to the environment.

Time: 15-40 minutes per subject

Format: Video tape with self teaching exams. In-depth supplements for Professional and Class A certifications require reading of selected references on subjects of this module; self teaching exams relate to reading. Completion of self teaching examinations will not satisfy Module 2 certification requirement. An additional formal written examination would be required for certification.

Subject	Content
Varieties of Hazardous Wastes and Their Characteristics	. Categories of hazardous wastes (eg explosive, noxious, toxic, ecological hazard, etc.) . Health and safety hazards in handling each category of hazardous waste . Community health and safety hazards . Environmental effects of hazardous wastes by category
Safe Operating Procedures for Hazardous Wastes	. Explosives . Flammable materials . Toxic materials
Facility Plan of Operation	. Elements of a plan . Examples of plans . The role of the permit
Contingency Planning	. Definition of a contingency . Examples of a contingency . Elements of a plan . Discussion of drills

Subject	Content
Emergency Procedures	. First aid and rescue . Fire fighting
Facility Monitoring	. Rationale for monitoring (i.e., for plant operation and for compliance with permit) . Log of wastes coming in-type and quantity . Accounting for the disposition of the wastes . Monitoring the ambient environment
Reporting and Record Keeping	. Forms for facility record keeping . Comptuer vis a vis manual processing of data . Filing and storing records . Legal requirements: data required and forms . Legal requirements: frequency of reporting

TRAINING MODULE 3

Title: Hazardous Waste Treatment, Storage, and Disposal Site Operation

Objective: To provide operating procedures for the major classes of hazardous waste treatment and disposal sites.

Options: (a) Land disposal (b) Incineration (c) Final treatment (d) Above ground storage

Theme: Final disposal and treatment techniques may be very specialized for the type of facility and wastes involved. Strict adherence to the plan of operation and congnizance of the hazards are required.

Time: 4-8 hours each training option

Format: Video tape with self teaching examinations. These can be supplemented with classroom instruction, group discussion, or site visits.

OPTION A: LAND DISPOSAL

Subject	Content
Categories of Land Disposal	. Approved Landfills . Secure Landfills . Near-Surface Burial . Deep Burial
Categories of Wastes Suitable for Land Disposal	. Toxic materials . Bioconcentrators . Carcinogens . Radioactive, etc.
Land Disposal Procedures	. Burial techniques . Recordkeeping . Segregation of wastes
Disposal Site Maintenance	. Ground water/leachate monitoring . Surface runoff control . Access control . Site restoration

OPTION B: INCINERATION

Subject	Content
Types of Incineration	. Multiple Hearth . Fluidized Bed, etc.

Subject	Content
Categories of Substances Suitable	. Flammable compounds . Toxic Gases, etc.
Operating Procedures	. Process control techniques . Hazardous waste handling . Maintenance of air pollution . Handling of residues control equipment

OPTION C: FINAL TREATMENT

Subject	Content
Types of Final Treatment	. Oxidation/reduction
Processes	. Neutralization . Chemical degradation . Detoxification . Open burning/detonation . Hydrolysis . Biological degradation . Resource recovery
Categories of Substances Amenable to Final Treatment	. Strong acids/bases . Hazardous organics, etc.
Operating Procedures	. Process control parameters . Handling the residues . Recordkeeping

OPTION D: ABOVE GROUND STORAGE

Subject	Content
General Precautions for Storage of Wastes	. Segregation of waste types . Cleanliness of containers . Prevention of siphoning
Precautions for Specific Wastes	. Flammable liquids . Corrosives . Radioactive wastes

TRAINING MODULE 4

Title: Site Specific Training

Objective: To provide supervised on the job training relative to operating a facility for processing of hazardous wastes.

Theme: The general knowledge of Modules 1, 2, and 3 must be applied in the context of the unique features of a particular facility; this can be achieved only by specific training on the job which is oriented about applying such knowledge to specific job tasks. This module is intended for new personnel so that they may become familiar with the facility operation; it is not a part of continuing training.

Time: 60 minutes per week

Format: Supervised periods may be formal, i.e., in a classroom situation, or informal, i.e., on the job. The instruction is to be done by a person who has Class A certification qualifications, or greater. Question and answer sessions are encouraged. Certification will consist of sign-off of completion by a Class A certified person and by the RPC.

Subject	Content
Purpose of the Facility	
Authorization for the Facility to Operate	. Permit . Certified operators . Responsible ownership . Responsible Class A or Professional in Charge
Plan of Operation	
Record Keeping	
Reporting	
Plant Maintenance	
Contingency Plan	
Emergency Procedures	
Safety Protocols	
Operation of Plant Equipment	
Operating Rules	

TRAINING MODULE 5

Title: Optional Basics

Objective: To provide a digest of some of the essential operational concepts, or procedures, or information for a given subject area.

Theme: The knowledge underlying a hazardous waste operatoin is comprised of a number of subject areas. A graphic understanding of some of the key conceptual ideas or procedures will aid in developing rational and knowledgeable behavior patterns and responses to the large variety of situations which occur both in day to day operations and in emergencies. This module should provide access to video tapes which cover a range of topics. The library should be thought of as expandable, i.e., not constrained by the subject below.

Time: 30-60 minutes each subject

Format: Video tape supplemented by self teaching examinations. Tapes may also function as a point of departure in classroom teaching demonstrations, drills, practices, etc.

Subject	Content
Intuitive Physical Chemistry (All of the ideas of this course should be demonstrated as laboratory experiments and then illustrated in terms of various field situations.)	. Reactions - what it takes to make them happen, i.e., negative free energy of reaction . Heats of reaction (i.e. put a thermometer in a beaker of water and pour in acid; show the rise in temperature) . Equilibrium and distribution of species . Precipitation reactions . Vaporization . Adsorption reactions . Ion-exchange reactions . Complexes
Applications of Physical Chemistry in Facility Operation	. Leaching from land fills as an equilibrium phenomenon . Ground water disposal and the role of adsorption and ion-exchange . Removal of heavy metals by precipitation . Gas stripping . Removal of organic by adsorption

Subject	Content
Toxicology Fundamentals	. Categories of toxic substances . Concentration of toxic substance and duration of exposure to it . Concentration by the food chain . Toxic effects
Explosives and Flammable Substances	
The Contingency Business - Parts of the Infrastructure	. OSHA - its business and its literature . Manufacturing Chemists Association . National Safety Council . State Health Departments . EPA . Local police, fire, and medical services

TRAINING MODULE 6

Title: Remedial Topics

Objective: To provide a means for facility personnel to learn or review some of the skills and knowledge required which is expected of most plant personnel at the high school level.

Theme: The basic knowledge and skills required to function at a hazardous waste facility at a Class C certification level is reviewed starting at a beginning level and progressing to the equivalent high school level, but limited in scope to the job need to know requirement.

Time: 15-30 minutes each topic within respective subject

Format: Video tape and self teaching examinations.

Subject	Content
Mathematics	. Arithmetic operations . Calculations of volumes, rates, loadings, capacities, etc.
Chemistry	. Elements and Compounds . Reactions . Equilibrium

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TRAINING MODULE 7

Title: Continuing Training

Objective: To provide a format for continuing the training.

Theme: Training may have a variety of formats. The important requirement is that it be continuous so that new persons are properly indoctrinated and that the existing personnel may stay aware of new developments and maintain their awareness of contingency procedures.

Time: Variable depending upon the specific training activity.

Format: The variety of training formats may include: teaching short courses, individual viewing of video tapes, facility classroom training sessions, facility drills of various sorts, attendance at various short courses, etc. However, despite the encouraged flexibility, continued training at the site should be a part of the facility training program. On-site training should include: contingency plan drills, first aid rescue practices, safety meetings, etc. Attendance at these sessions should be a part of the personnel record of each employee. Also, the record of sessions should be a part of the reporting requirements for each facility or at least available to regulatory personnel.

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